THE

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THE

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LESSONS OF THE TRAMWAYS EXHIBITION.

IT is usual to point out that the lateness of the tramways industry in this country will be counterbalanced to our advantage by the avoidance of the errors and omissions of America. As a fact, however, the advantage which has been reaped from this source is inconsiderable, and British practice is, in most things, as advanced as American. The extraordinary increase of traffic consequent on electric traction was not foreseen in America, yet it took place so often and so uniformly, that it might have been assumed as a safe precedent for this country. Such has not been assumed, and some English lines have been laid out and equipped with many of the avoidable errors of early American practice in permanent way and car equipment. We are using what are practically ordinary horse cars, only somewhat larger, and fitted with motors. Now what is an ordinary horse car? It is a long vehicle with a short wheel base. In taking curves and points and turn-outs, this car, with its short wheel base, never ran very fast, because it was limited in speed by the capacity of the motive power. Moreover, a careful driver would always cause his horses to pull sideways sufficiently to pull the head of the car into the correct line of motion, so that when the wheels took the diversion, they were not exposed to the sudden wrench that would have come upon them if the car front were not already being urged to follow in the same direction. But when this car was taken and enlarged, and electric motors were placed beneath, it was enabled to run at a much higher speed, and when such a car with its short wheel base runs into a turn-out something like 12 feet of car have already run past the point of deflection before this is entered by the leading wheels. As a car may have a length of 28 feet or 30 feet, and a wheel base of only 6 feet, the stress upon the wheel flanges and the racking strains upon the whole car and its equipment are very severe. This all arises because, in the first place, track and turn-out is made just as it was in the old horse-traction days, and the ordinary electric car is but a glorified horse car with the worst faults glorified or magnified in an excessive proportion. Some electric tramways would seem to have been constructed in a manner that proves there has been little expectation of much traffic, no recognition of the fact that facilities for traffic produce traffic, a disregard of the necessities of quicker speed, and an absence of any grasp of the necessity of dealing with the tramcar in the light of a carriage. Thus it is that we see the continuance of the short wheel base, and that so many exhibits at Islington are of single trucks designed to overcome what they can at best but mitigate—the placing of a long body on a short wheel base. All the design in the world cannot, by the most ingenious system of springs, overcome the fact that a long body cannot be carried over an uneven track without galloping effects, unless the wheel base is proportionately long. The object of the short wheel base is, of course, to enable a four-

wheeled car to pass round the small curves that are necessary on a tramway, for square corners in narrow streets do not permit of curves of large radius. Apparently the only means of overcoming the difficulty is the use of long cars and bogies. The exhibition shows some evidence that the subject is not being neglected, for the so-called maximum traction truck is coming into use. The difficulty involved in the employment under a car of a couple of four-wheel trucks is, of course, that only half the weight of the car is available for tractive purposes, and already gradients are being surmounted by electric cars that demand the full adhesion of the car. To secure the maximum traction with only two motors, the maximum traction truck has been evolved. In this truck one pair of wheels is much smaller than the other, and the weight of the car body is carried by a point in the truck frame very much nearer to the large pair of wheels that are alone motored. This method is a compromise, of course, and it is a question whether the "maximum" traction thus secured is sufficient. It may be five-eighths, or at most three-fourths, the total car weight, and we cannot think that this will always be satisfactory. The expense of four motors is looked at somewhat askance, or otherwise the difficulty would be at once solved by the use of two trucks with all wheels alike, and four motors to a car. It is not necessary that such motors should be as large as existing motors. Four motors may, perhaps, be wasteful of current. We have heard them complained of on this score. At the same time the series parallel system of control should render it possible to control such a car in a manner to avoid much of the loss now due to resistances. Four motors could be worked in series, or in parallel pairs, or all in parallel. Obviously the use of such long cars as would be properly suited to four motors supposes a sufficiency of traffic. We see no reason to doubt this sufficiency in most cases, and in other cases it appears exceedingly probable that the saving they would effect would more than counterbalance their disadvantages. In the first place, on all the busy lines they would reduce the wages item to one-half. There are already several lines in this country that have been converted from steam to electricity. On the old steam lines, long double truck cars were run, and these had invariably seating accommodation on the top. They have been replaced by smaller four-wheeled cars whose relative carrying capacity is about one-fourth that of the old cars, and the wages item is therefore doubled per passenger. Any higher average speed of the electric car helps to reduce somewhat this excessive labour charge. In addition to reducing the carrying capacity inside there is the top seat question. What is the reason for the existing weakness for single-deckers? Is it simply because in this country car practice has slavishly followed American methods? They do not use top seat cars in America, for very good reasons. The temperature in summer goes up to about 150° F., and in winter it drops to 20° or 30° below zero. Obviously the top seat car has a very short time limit—about a month in spring and a month in autumn. In England most people can ride outside a car all the year round. Americans do not fancy the outside seat. Englishmen prefer it, and the multiplicity of designs for dry seats to be seen at Islington is ample evidence of the general opinion. America has come, or is coming round to the long car and the four motors though it is not to be expected that the outside seat will be adopted.

A further advantage of long cars is that they will run well over a track that is impossible or undesirable for single-truck cars. The short car gallops so badly over faulty rail joints that the trolley is certain to be frequently dewired. Dewiring means delay; often it means entanglement with guard wires and the destruction of the overhead work. Moreover, its ill-effects extend to the power house, where circuit breakers are put out and all manner of delays result. The damage to the cars is too well known to require more than passing comment.

The conviction cannot but force itself upon the mind of any mechanical engineer that the initial stages of electric traction work have been very badly engineered. The experience of railway men has been practically ignored. The long wheel base has long enough been recognised as a necessity, and the only means of securing it has been by the independent truck in some of its various forms. Though not great, the experience of electric traction in this country is already sufficient to warrant the use of something more businesslike than the enlarged horse car, and the more so, as pointed out above, that so many lines, now electrically worked, have hitherto been worked by steam, with cars of very considerable length. We are convinced that a bolder grasp of the question is now most necessary and desirable.

COMBINED LIGHTING AND TRACTION STATIONS.

The question whether it is better policy to generate electrical power for both lighting and traction in a single station, or to keep the two functions entirely separate, is not only one of absorbing interest, but in view of the large number of installations of both kinds being laid down at this time, is also of great importance. That opinion is divided on this point is evident, from the fact that such large towns as Glasgow and Cardiff are erecting separate stations, while on the other hand, Manchester and Southampton are combining the two systems—even though in the latter case the lighting supply is with alternating current.

The point was not dealt with by Mr. Quin in his paper before the Municipal Electrical Association (abstracted in another place), which was specifically confined to the management of the two undertakings; nevertheless, it is inseparable from the latter question, and must be settled at the very start of any new municipal installation, even before it is definitely decided to carry on both operations.

The present tendency is on the whole in favour of combination: but this is, we think, in many cases, rather due to the profound and well-merited confidence reposed in their electric lighting engineers by the authorities concerned, than to mature deliberation on the relative merits of the rival systems.

For small townships, where neither lighting, nor power, nor traction is likely ever to become of large dimensions, we think there can be no doubt whatever as to the advisability of combining the works, as far as possible, and placing the whole under the supreme control of an electrical engineer. While there is little to be gained in economy either of capital, in the first instance, or of cost of generation afterwards,

there can be no doubt but that a smaller engineering staff will suffice for the joint undertakings than if they were separate, and their time will be employed to better purpose.

On the other hand, when both operations are carried on upon a large scale, we are driven to the conclusion that the engineers must specialise. How can a man who is responsible for the supply of electricity to 200,000 lamps be expected, or be able, to devote due attention to the control of a service comprising, say, 200 tramcars? He must be provided with highly skilled assistant engineers, each of whom is capable of taking sole charge in his own department; consequently, we have here no economy in management, but the reverse. As for the division of profits between the two departments, that is a matter of small moment to the community. The aim of the authority should undoubtedly be to provide lighting and transport at the lowest possible rates, and if this cannot be attained by combination, the management—and therefore the works—ought to be separated.

In response to a recent request, we have received a number of interesting communications from engineers who are carrying out important undertakings of both kinds, from some of which we quote as follows:—

Mr. J. F. C. Snell says, regarding the question of joint management, that he is decidedly of Mr. Quin's views, and his Council has made the chief electrical engineer the head not only of the electric lighting department, but also of the tramways. Mr. Snell's assistant engineer takes charge of the car shed and tramway line, the up-keep of the rolling stock, and the training of the motormen, while the traffic manager controls the cars on the line, the motormen and conductors, and deals with the receipts from the cars, &c. "I have no doubt that this system will work quite well in a system such as ours, where the maximum number of cars we are likely to require will not exceed 100. I doubt if, however, in a large system, the chief electrical engineer will have sufficient time to attend to the general management of a large system, such as what will be in use in our big towns, because he has to act not only as chief resident engineer, but in most cases (as in my own) as consulting engineer and adviser as well. It is true that this latter *rôle* will only be exercised for a limited number of years, after which the work will be easier, when the tramways are constructed and in full running order. For moderate-sized towns, however, I strongly believe Mr. Quin's suggestions to represent the best policy."

Mr. A. B. Mountain takes the view that the power required for electric traction will ultimately represent such a small proportion of the capacity of the generating station, that combination of the lighting and traction as far as the generation of electricity is concerned must result in reducing the cost of energy to both departments. Estimating the lighting plant for a town of 100,000 inhabitants to have an output of 30,000 to 40,000 H.P., and the traction plant for the same town to be of 2,000 H.P. for the supply of 100 cars, Mr. Mountain regards it as foolish to expect separate generating works to give such economical results as could be obtained by combination, and considers that the results already obtained have conclusively proved that putting down a separate power station is a great mistake.

On the other hand, Mr. Mountain anticipates that in the future the network of tramways about a town will extend many miles into the surrounding country, and that the towns will become purveyors of electrical energy to the smaller districts in their neighbourhood, necessitating either a number of low pressure stations or a single large works generating at high pressure. This state of things, however, is a matter to be dealt with in the far future, and is, we think, somewhat in conflict with the foregoing estimate.

Mr. Mountain aptly points out that out of 48 municipalities only three have voluntarily adopted separate stations, all the rest having arranged to supply the energy for tramways from their lighting stations.

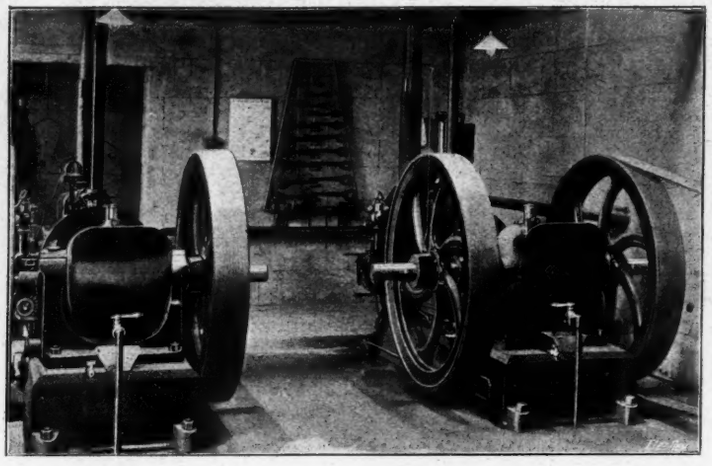
Mr. J. S. Highfield is strongly of opinion that for a town of small or moderate size, where the tramway system does not exceed, say, 25 miles of track, the most economical arrangement is to generate the whole of the electrical energy required, whether for lighting or for traction, at one central station, and to have the whole supervised by one committee and by one engineer. "There are towns where some engineers would put down two power stations, owing to the extended length of the tramways, or owing to the load areas for lighting and tramways not coinciding. Even in this case I consider that one committee and one engineer should control the whole undertaking, and if two stations be decided upon, I think the plant should be so laid out, that it may be used for supplying both to the lighting and traction feeders. For controlling the distribution of the current and the working of the tramways, I think that, preferably, sub-committees from the parent committee form the best system for large undertakings, whether one station or several stations is found necessary, and there are cases where more than one station is not a disadvantage. But in all cases one engineer and one committee should control the works and the generation of electrical energy" for whatever purpose. Where the business is being rapidly extended, the chief engineer has his hands quite full enough in laying out new work to occupy the whole of his time, and he should appoint thoroughly capable engineers to take charge of the power station. "It seems to me it is essential that the chief should not waste his time in going into matters of routine detail; work which can be better done by men who are constantly employed on it." "I should, in conclusion, like to point out that the plant required for general supply is sure in the future to greatly exceed that required for working local tramways; hence, whatever can be said in favour of having one undertaking to supply electric energy to one area at the present time, in the future the claims for such a policy will be still more weighty."

From the above remarks it will be seen that Mr. Highfield is in general agreement with our other correspondents, and with our views expressed above as regards towns of moderate size. But it should be borne in mind that when a large demand for power has been worked up, it will be impossible to supply it from machines and mains which are at the same time supplying lamps; in fact, the power load ought to be supplied by the tramway generators.

In cases where the demand becomes so large as to render necessary the establishment of a high pressure generating station, removed from the centre of the area of supply, there is a simple way in which to enable the same main generators to supply lighting, traction, and other loads, even of the most variable character, without detriment to the lighting pressure; that is, by the use of synchronous motor-generators for the lighting circuits. With this system the secondary pressure, be it direct or alternating, depends only on the frequency of the supply, and is unaffected by large variations of the pressure applied to the motors. This, however, is too large a subject for discussion here.

ELECTRIC LIGHTING OF DOXFORD HALL, NORTHUMBERLAND.

We give below some particulars and photographs of an electric lighting installation, recently put into the residence of A. Browne, Esq., of Doxford Hall. The plant consists of two 12½-B.H.P. Hornsby-Akroyd oil engines, each driving a Crompton shunt-wound dynamo by belt, and two sets of accumulators.

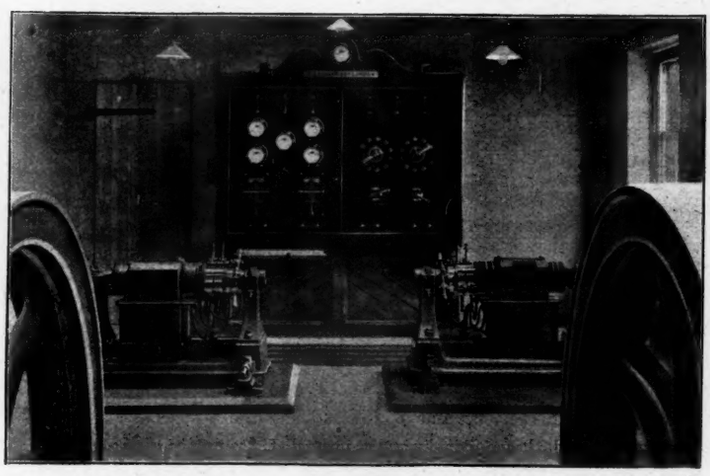


Doxford Hall: Oil Engines.

The installation is a very complete one. There are about 300 incandescent lamps distributed throughout the house and outbuildings, as well as a searchlight fixed at the top of the house, while electric irons in the laundry, an electric horse-clipping machine, and various motors for pumping and other purposes are in use. The accompanying photographs show respectively the dynamos and switchboard, the engines, the drawing room, and the dining room. In accordance with the dictates of artistic illumination, most of the lights in the two rooms last named are hidden from view, and are therefore not seen in the photographs.

Doxford Hall: Drawing Room.

The oil for the engines is stored in tanks some distance from the engine room, whence it is pumped to a tank above the level of the engines, thus enabling the engine tanks to be filled as required by simply turning on a tap. The plant has now been running over three years, during which time there has not been the slightest hitch; the whole installation was carried out by Messrs. F. A. Glover & Co., of 97, Queen Victoria Street, London. The switchboard is arranged on the principle uniformly adopted by this firm for all their country house installations, and is so simple that an ordinary gardener or groom can easily be taught to run the plant in a fortnight. The cost of lighting this house by electricity shows a considerable saving over the previous system, which was a mixture of oil lamps and gas manufactured on the estate.



Doxford Hall: Dynamos and Switchboard.

THE DISTRIBUTION OF ELECTRICITY.

Mr. George Wilkinson, the borough electrical engineer of Harrogate, read a paper (abstracted in our other columns), on the distribution of electricity before the Municipal Electrical Convention, in which he rightly emphasises the great importance of the distributing system, and urges more attention being paid to that portion of the plant. As duplication is obviously impossible, and as the first intimation that generally reaches the station engineer of trouble outside comes from the consumer whose supply is defective, or interrupted, it is surprising that in many undertakings the mains are left in the hands of juniors and new comers, while the greatest attention is paid to the plant in the works.

At one time it was the fashion to extol the necessity for everyone being a "first class mechanical engineer," which phrase usually meant, in the mouth of the speaker, that he considered the ability to earn a livelihood as an engine fitter was the first requisite of the aspirant for a supply station berth, quite ignoring the fact that the proportion should rather be one half business man, one quarter chemist and electrochemist, and the rest general mechanic. Mr. Quin has already, in his paper on "Faults," given the M.E.A. well-considered opinions on how mains troubles may be avoided, and it is a good sign that increasing attention is being devoted to the commercial and the physical problems arising from what Mr. Wilkinson collectively terms the distribution of electricity.

In the works proper, a fault or breakdown ought not to interfere with the supply. Supervision and skilled attention can render the consumer's lamps almost safe from extinction, although a momentary flicker cannot be prevented. But outside, the distributing engineer is handicapped by so much of the apparatus under his charge being out of sight, by the curious chemical and thermal actions that go on, and by the

Doxford Hall.—Dining Room.

area over which he has to exercise supervision. As the paper says, "it is not comfortable to feel that a bad fault may develop upon the mains at any moment, and stop the supply to a large proportion of the consumers." The author hits the nail on the head when he condemns the spirit of parsimony which would prevent the engineer obtaining the very best cables and joint boxes money can buy.

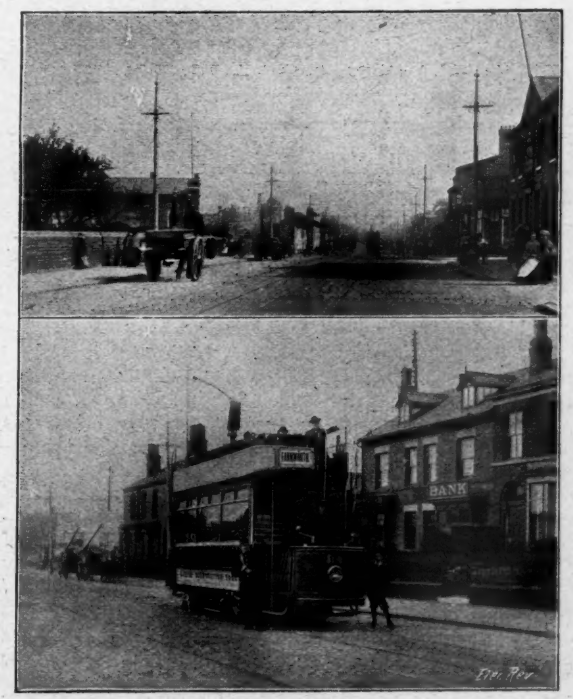
The systems of mains for three-wire distribution are classified under the heads of (*a*) bare conductors, (*b*) Callender or B.I.W. Company, solid, (*c*) concentric, (*d*) three core, (*e*) single cables in conduits. The principal objection to the first system is the difficulty of finding space under the footways, and it might be added that many towns where bare conductors are laid have found it advisable to adopt the strained-up principle (*e.g.*, Aberdeen). Mr. Wilkinson considers that the solid system is that most widely used for three-wire distribution, and that a carefully laid network is remarkably free from faults. This opinion will, we believe, be endorsed by those who have had extensive experience with mains. Mechanically, electrically, and chemically such a system possesses strength and stability. It is not easy to see wherein lies the distinction between (*b*) and (*c*) or (*d*), because no one nowadays buries cables directly in the ground if money is available for the troughing or protection which forms the mechanical safeguard against accidental damage.

Mr. Wilkinson considers draw-in systems as only suitable for feeders. With this opinion one is quite able to concur. Years ago Mr. Jeckell, of South Shields, enunciated as a general principle "draw-in for feeders; solid, or buried for distributors," and this is exactly what has happened in most cases. The advantage of the three-core distributor, as against triple-concentric, is the ease with which service connections are made; it is also stated in the paper that while a service joint box costs £2 to £3 5s. for "a triple," it can be obtained for half this sum in the case of a three-core cable.

The general question of distribution has been discussed, argued, and fought over so often, that there is really nothing new to be said, and Mr. Wilkinson is successful in making interesting what he has to say about things said often before. When he comes to joint boxes he is more practical, however, and opens up new ground. The cost of joint boxes is undoubtedly an element of anxiety to many engineers in the smaller provincial towns. The Wordingham pillar terminal is selected as a good example of low pressure connections, while a modification of the Brush Company's "dry" joint box of 1891 seems to have given satisfaction for high pressure alternating. Probably there is no better street fuse and switch box than that now being made by Ferranti, but it is expensive. A cheaper type was described by Mr. Kilgour in a paper he read some time ago before the Northern Society of Electrical Engineers. The weak point in many of these boxes is undoubtedly the connection between the cable and the box terminals. Mr. Wilkinson prefers the method of clamping the outer strands of a concentric cable between two discs at right angles to the axis of the cables, a practice probably introduced by Felten & Guilleaume, and certainly very extensively used by French and German engineers. Of course if the cable be cut right through a ferrule slipped over the inner conductor and below the outer strands provides a solid bed upon which to screw down the bridge of the terminal block, but the Continental method is perhaps more generally satisfactory, although taking up more room.

The suggestion of sealing joint boxes by running in compound between a light internal box and the main outer box was actually used in some of the house service boxes put down by Callender's in Liverpool 11 and 12 years ago. As Mr. Wilkinson says, too great reliance is placed upon compound in joint boxes. After all a joint box mechanically made should be sealed by a metal-to-metal faced joint with a thin gasket ring or jointing material: no trouble should be met with if the casing is heavy enough, but such boxes are often made too light. A good example of a service or joint box is the B.I.W. Co.'s service box such as is used in the City of London and elsewhere.

The paper may be said to be a protest against un-



Street Views at Farnworth.

mechanical work. The gas companies, water companies, and hydraulic power companies have long since adopted standard patterns, heavy, mechanical, and well made, for street valves, receivers, inspection chambers, &c. If electrical engineers would only give up house transformers, the lavish use of compound, cheap, and light castings, and flimsy fittings, most of the troubles with "boxes" would go

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for ever. The M.E.A. convention is useful in a very great degree, if at its yearly meetings those who have to provide the funds and control expenditure only learn that their engineers can no more prevent faults on mains if joint boxes and cables are of the cheap and nasty type than they can stop leakages from steam-pipe systems if the flanges are little more than angle-irons, and the valves the cheapest on the market.

FARNWORTH ELECTRIC TRAMWAYS.

This tramline, which has been converted from horse traction, is a continuation of the Bolton Tramways, and extends from the Bolton boundary through Farnworth to Kearsley. The line which was opened to the public on Good Friday is double throughout. The existing tram rails, which have been bonded at every joint, have been utilised, except at the Kearsley end, where new movable points and crossings have been laid down; this at present being the terminus.

The span wire system has been adopted, the spans being supported, as shown in our photographs, on ornamental poles which are fixed about 40 yards apart. The poles are of steel made up in three sections and weigh approximately 800 lbs. each.

The trolley wires are carried directly over the centre of each line, and are supported by means of specially designed straight line hangers or pull-offs as required. Guard wires are fixed at a height of 18 inches above the trolley wire wherever telegraph or telephone wires cross the route.

The necessary section and feeder boxes are fixed, but at present the current is supplied from the Bolton Corporation mains, pending the completion of the Farnworth Council's generating station.

The whole of the overhead equipment and bonding of the rails has been carried out by Messrs. George Hill & Co., of Manchester.

The line was inspected by Mr. Trotter and Colonel Yorke on behalf of the Board of Trade, who, we understand, expressed their complete approval with the manner in which the work has been carried out.

Messrs. Lacey, Clirehugh & Sillar acted as consulting engineers to the Farnworth Council.

PARIS EXHIBITION.

Messrs. Mather & Platt, Limited, and Messrs. Galloway have sent a joint exhibit to the Paris Exhibition illustrating a typical combined electrical plant.

The generator is one of Mather & Platt's multipolar machines, designed for use on lighting or power circuits. It is of a substantial design, and all details with regard to accessibility and compactness have been carefully considered.

The machine is shunt wound, and has an output of 230 to 250 volts and 1,400 amperes at 105 revolutions per minute. It is, however, capable of carrying a temporary overload up to 1,600 amperes, and is arranged to run in parallel with other generators in the Exhibition. It is of the 18-pole type, the coke ring and magnet cores are of cast-steel, and arrangements are made so that the lower half of the ring can be lowered into the foundations, enabling any magnet winding to be taken off or to be easily inspected if necessary.

The armature is central hung, being mounted upon the crankshaft between the two bearings; it is not keyed to the shaft, but bolted direct to the heavy fly-wheel with which the engine is provided. This method of attachment ensures all fly-wheel effects being transmitted direct to the armature, no keys are subjected to an unnecessary strain, and a very stiff job is ensured.

The armature is of the slotted type, the bars being laid in insulating troughs, and entirely embedded in the iron of the core, which is the usual practice in generators of this type, and efficiently protects the windings from damage.

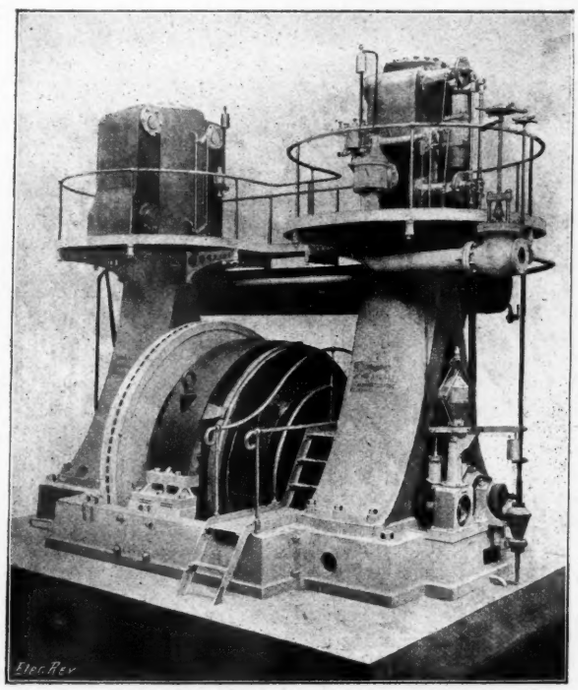
Special attention has been paid to the question of efficient ventilation both of the armature and commutator, and the machine can consequently carry the full load for long periods with but a small rise in temperature.

The commutator is of large diameter and width, and of a design and construction up to the highest standard of modern practice. The current is collected by carbon brushes, mounted in special holders, which admit of the contact pressure being adjusted as may be required, and each holder is fitted with "hold-off" attachment.

The efficiency of the generator is approximately 94 per cent., which, with an engine efficiency of 91 per cent., gives a combined efficiency of 85·5 per cent.

The engine, which is of the compound inverted type, is by Galloways, Limited, and is capable of developing up to 630 I.H.P., with high economy when provided with steam at 10 kg. per square centimetre, and going at 105 revolutions per minute.

The high pressure cylinder is 16 inches diameter, and the low pressure 34 inches, both being arranged for a stroke of



Mather & Platt Exhibit at Paris.

5 feet; the cylinders are erected on standards of an enclosed type, the fly-wheel and dynamo being between.

The distribution of steam to both high and low pressure cylinders is effected by Corliss valves, having separate chests for steam and exhaust, both sets of valves deriving their motion from eccentric fitted on crankshafts driven from the end of the main crank pins. The whole of the valve gear is arranged on the outer sides of the standards, and thus, owing to its accessibility, admits of ready adjustment at any time from the *outside* of the engine, and further, in conjunction with the enclosed design of the standards, avoids the risk of any oil, steam, or water being splashed upon the dynamo.

The governor, which is of the high speed centre weight type, is positively driven from the valve shaft, and it automatically controls the expansion of steam in the high pressure cylinder: provision is also made for the adjustment of speed by hand while the engine is running.

A neat and substantial platform is erected for access to the whole of the cylinder parts, valves, &c., and this is designed so as to give light to and convenience for lifting the dynamo parts.

An efficient system of forced lubrication is adopted, and the steam is superheated between high and low pressure cylinders.

As is now generally adopted for central station installations the condenser, which is of the ejector type, is fitted with an independently driven water pump.

The bed-plates have been arranged to meet the whole of the straining actions within the structure of engine and dynamo, and the whole is absolutely self-contained.

The engine throughout is of massive and substantial construction, and it is needless to say that great thought and attention has been devoted to the design and manufacture of every detail.

DESTRUCTOR AND ELECTRIC POWER STATION AT ST. HELENS.

By J. S. HIGHFIELD.

In view of the great interest at present taken in the combination of destructor and electric supply works, with the object of utilising any available heat that may be obtained from the former, a short account of these works and the results attained may be of assistance to other local authorities.

The electric power station has been erected and equipped by the Electric Supply and Tramways Committee, who supply energy to work the local tramways, and also give a general supply to private consumers for light and power. The plant consists of four engines with direct coupled generators, of a total capacity of 600 KW. A fifth engine is on order with a capacity of 300 KW. The engines are of Willans & Robinson's three-crank compound type, and work condensing. The condensing plant consists of a Wheeler condenser, capable of dealing with 20,000 lbs. of steam per hour; this condenser works in conjunction with a Klein cooling tower, and the plant suffices to maintain a vacuum of 25 to 26 inches. Adjacent to the electric works the Health Committee erected a destructor plant, the borough engineer, Mr. G. J. C. Broom, being responsible for the design of the works; the contractors for the work were Messrs. Beaman & Deas. The destructor works are under the supervision of the electrical engineer and his staff, who are responsible for the proper burning of the refuse. The weighing of the refuse and the removal of the clinker are in the hands of the borough engineer. The Health Committee pay for this supervision, and are paid in return for the number of units generated by the steam that is supplied by the destructors.

In this way the Health Committee are entirely responsible for the destructor works, and own the whole of the boiler plant, feed pumps, and steam pipes up to the main range in the engine house.

The destructor plant consists of two furnaces, each having two cells on the Beaman & Deas principle; the hot gases from each furnace pass through a combustion chamber, and then through a Babcock boiler having 1,740 square feet of heating surface. After leaving the boilers the gases pass through a Green's economiser having 96 tubes. A superheater is fitted to each boiler, which serves to give about 100° F. of superheat to the steam. The furnaces are fitted with closed ashpits, and forced draught is supplied under the hearths by a centrifugal blower, driven by an electric motor. This blower is designed to blow three furnaces, and hence works inefficiently when used to blow only two furnaces; at present only one furnace is used to supply steam to the electricity works. A test was carried out on one furnace by the electrical engineer, to determine the weight of refuse that could be destroyed, and other data which are given in tabular form below.

Test of No. 1 Furnace and Boiler of Beaman and Deas Destructor.

Date of test, April 10th, 1900.
Duration of test (10.30 a.m. to 5.50 p.m.), 7 hours 20 minutes.
State of weather, fine, windy.
Nature of fuel, unscreened ash-bin refuse of average quality.
Total weight of refuse burned, 16 tons 18 cwts. (37,912 lbs.)
Weight burnt per hour, 5,169 lbs.
Weight burnt per square foot of grate area, 103 lbs.
Total weight of clinker and ash, 5 tons 6 cwts. 1 qr. (11,900 lbs.)
Percentage of clinker and ash to refuse, 31·36 per cent.
Total water evaporated, 48,216 lbs.
Water evaporated per hour, 6,575 lbs.
Water evaporated per hour from and at 212° F., 7,955 lbs.
Water evaporated per pound of refuse, 1·27 lb.
Water evaporated per pound of refuse from and at 212° F., 1·54 lb.
Temperature of water in tanks, 46° F.
Temperature of water from economiser, 190° F.
Average steam pressure, 132 lbs.
Average air pressure under grates, 3·1 inches of water.
Temperature in combustion chamber by copper test, 2,000° F.
Temperature in main flue before economiser, 537° F.
Temperature in main flue after economiser, 358° F.
Percentage of CO_2 (average of 21 readings), 10·4 per cent.
Percentage of O (average of 20 readings), 9·16 per cent.
Men employed on furnace, two firemen and one labourer to feed the refuse into the cells.

The very high results attained could not be kept up in practice, the labour being altogether too heavy, and the depreciation of the furnace would be very great at such a high rate of combustion as 103 lbs. per hour per square foot of grate area.

The working results from day to day are a better criterion of the utility of the destructor than the special figures attained during the short test quoted above.

The first shift of men, three in number, come in at 5 a.m., and have steam raised by 6 a.m., when the first engine is started; this engine charges a storage battery until 8 a.m., and is then shut down. At 7 a.m. a second engine is started to supply energy to the tramways; the engine is of 300 I.H.P., and is direct coupled to a shunt wound generator of 200 KW. The plant is run non-condensing, except when the load is abnormally heavy, in order to take all the steam generated. As many as 20 cars can be operated continuously when the plant is working condensing. The boiler also supplies steam to a mortar mill which works 14 hours a day, and also to a winch which is used occasionally. The quality of the mortar made from the clinker is excellent. The destructor plant is worked from 2 p.m. on Monday till midnight on Saturday. No burning is done on Sunday, and on Monday the flues are thoroughly cleaned. For supplying the extra steam required when the lighting load comes on, one or more of the Lancashire boilers at the electric works is utilised according to the time of the year, and this boiler or boilers also takes the load on Sunday and Monday, to the time of starting work at the destructors. The destructor plant has now been working since January, and the results shown in the attached table are maintained steadily week by week. No coal whatever is used in the destructor furnaces. The total quantity of refuse at present available is about 200 tons per week, and a second furnace is worked one shift a day in order to burn this amount. It is probable that a third furnace will be erected, and the two boilers, instead of one boiler, as at present, will be kept under steam; proportionate results will certainly be obtained.

Results Attained in Ordinary Working during May, 1900.

Average weight of refuse burnt per week, 143 tons 18 cwts.
Average weight of clinker and ash per week, 40 tons 8 cwt.
Average weight of mortar made per week, 15 tons 2 cwts.
Average weight of refuse per shift of nine hours, 13 tons 1½ cwt.
Average units used to work fan, per ton, 9.
Average units generated from steam, per week, 7,062.
Average units generated per ton burnt, 50.
Average wages per ton burnt, 1s. 1¾d.

PARLIAMENTARY COMMITTEES.

South Wales Electric Power Bill.

On Thursday, June 21st, the Electric Powers Committee commenced the consideration of the South Wales Electric Power Bill, There were a large number of petitions against the Bill, but in the majority of cases they were not against the preamble of the Bill, but with respect to clauses. The Bill proposes to erect generating stations for the supply of electricity in bulk over a district in South Wales of 1,034 square miles, and including in it the towns of Cardiff, Newport, Swansea, and other large centres of industry.

Mr. Pember, Q.C., said that he appeared on behalf of the promoters, and, without making any comparison which might appear invidious, he might say that the South Wales Bill in its construction differed very widely from any of the Bills which had been considered by the Committee up to that time. The Bill was promoted by a number of gentlemen very largely interested in the industries of South Wales. There was no outside element of what he might call professional company-mongering at all, but it was a fact that the gentlemen promoting the measure represented through themselves, their partners, and their firms a combined capital of something like £23,000,000 in the district for which powers were asked in the Bill, and this sum took no account of the value of the mineral assets of the land in the district. The promotion of the Bill was undoubtedly costly,

but every farthing necessary had been provided by the promoters themselves, and no financier or director had any part in the matter whatever. The capital proposed was £750,000, in shares and £250,000 in debentures. The area they proposed to operate in was 1,034 square miles, but only three local authorities, he believed, had provisional orders, and in only 107 square miles of the area proposed to be covered were there means of supplying electricity, and at present only 965 customers were taking current, while the population was 1,000,000. Where supplied the average price now charged was 4½d. per Board of Trade unit, but the Bill proposed to charge 4d. for the first 400 hours and 2d. for any further use. The list of promoters showed the peculiar character of the Bill, for it included Sir W. T. Lewis (agent to the Marquis of Bute), Mr. R. Forrest (agent to Lord Windsor), Sir John Gunn, Mr. T. F. Brown (mineral agent for the Crown in South Wales), Mr. M. Robinson, Mr. A. Keen (Patent Nut and Bolt Company), Mr. P. Morel (Bute Dry Dock Engineering Company), and many others connected with engineering works, mining companies, &c. The first directors proposed were Sir W. Lewis, Mr. E. P. Martin, Mr. R. Forrest, Mr. A. Hood, Mr. A. T. Walker, Mr. A. Keen, and Mr. T. Foster Brown. It was proposed to erect three generating stations—one at Neath, towards the west, just at the head of Swansea Bay; one between Pontypridd and Caerphilly; and the third near Pontypool. They took compulsory powers for the purchase of station sites with the sanction of Lord Cross's Committee, and the stations had been chosen by reason of their central position; first, with regard to the coal supply, and secondly, with regard to the estimated consumption of power in their neighbourhood. The general Electrical Acts were incorporated in the Bill, so that they would have the usual powers of laying mains. The area was probably as concentrated in its industrial activity as any in the kingdom, and was covered with a network of railways. No landowner, Chamber of Commerce, railway company, or body of traders or manufacturers opposed the Bill, and though the Cardiff, Swansea and Newport Corporations had lodged petitions against it, he submitted that the evidence would show that in taking this course they did not represent the views of the commercial interests in those communities.

On Friday, June 22nd, Mr. Pember, Q.C., concluded his address, and said there was no intention on the part of the promoters to prevent competition with local authorities.

Mr. E. H. Reece, mining and civil engineer of Cardiff and Westminster, gave evidence in place of his partner, Mr Forster Brown, and said his firm were agents for many large colliery owners in South Wales. At the present time the question of the cheap production of coal was exercising the minds of everyone in the district, the more cheaply worked mines having been exhausted. He understood that the promoters of the Bill would provide power at from £4 to £10 per H.P. per annum, and it was costing much more than that at the collieries at present. Some had electric installations at present, but only for lighting purposes.

Cross-examined by Mr. Wedderburn (who appeared for various local authorities), Witness said that if the promoters spent £50,000 on the undertaking they would have the right to supply the whole district, but, of course, the company would not ask for powers unless they did intend to supply.

Mr. Ram said if the company did not supply, the Board of Trade could revoke the order.

Mr. Wedderburn (to Witness): The General Act compels you to supply anyone on payment by the applicant of 20 per cent. of the cost. On the other hand, your private Act says that under no circumstance, except to the wholesale consumer, will you supply without the consent of the local authority. Which is it to be?—That is a legal argument.

Mr. Ram (for the promoters) said they would be only too glad to supply, but in order to protect local authorities who already had power to supply, they said: "We will not within your area supply without your consent." If the local authorities did not like that, the company would be only too glad to supply everybody.

Replying to Mr. FitzGerald (representing the Rhondda Urban District Council), Witness said the promoters had a sliding scale clause in the Bill, and they could only increase the dividend when they reduced the charge for electricity to 2½d. per unit. He was not aware that the second reading of the Bill was obtained by reason of them accepting the undertaking of Mr. Ritchie in the House of Commons that they would not supply within the district of any local authority without their consent.

Mr. Ram pointed out that directly it was found Mr. Ritchie had made the statement in the House of Commons, the promoters waited on him and said they could not agree.

By Mr. Lloyd (for Swansea, Cardiff, Newport, and Barry local authorities): It was proposed to use electricity for other than lighting purposes in mines. The mines defined a wholesale customer as one who took 20,000 units supply per annum, and he did not think that there were many, if any, customers at Swansea taking them. Barry could take a supply in bulk from them on arbitration terms, which he should have thought would be much cheaper for them to do than generate for themselves.

Mr. Rigg cross-examined witness on behalf of the Pontypool Electric Lighting Company: Witness said he did not think the company would ruin the Pontypool Company, but if they supplied cheaper the public would benefit. He did not see why Pontypool should be excluded from the area, because the Lighting Company there was a commercial undertaking, and would have to take the risk of competition.

Further examined by Mr. Shaw, on behalf of the Penarth Electric Lighting Company, Witness said if he sold in bulk to the Electric Lighting Company, the cost of distribution would be saved by either company.

In answer to the Chairman, Witness said electric power would be used in collieries for lighting, pumping, and hauling. In a great colliery 1,000 H.P. would be used for hauling purposes, and the charge by the Bill would be £10 per horse-power at the most, and they hoped it would be only £4. At present it cost them £15 per horse-power for fuel alone, and he would anticipate a saving of £10,000 a year in a great colliery raising 750,000 tons of coal a year.

Questioned by Mr. Bartley, M.P., Witness said he considered that the development of electric energy in the district was behind the times. He was a resident in the district, and he did not think the local authorities contemplated supplying electric energy except for lighting purposes. He did not approve of municipalities going in for trading on a large scale—they should supply what were really necessaries, but should not become trading companies. If municipalities were to engage in schemes such as they proposed progress would be retarded, because there would be no competition. He did not mind competition, and would not consider it unfair if within a comparatively short time another company was allowed to come in.

Mr. Wm. Brace, agent for the Monmouth Western Valleys District Miners' Federation, was called, and gave evidence as to the great advantage which would accrue to manufacturers from having this power.

Mr. A. Keen, one of the promoters, and having large commercial interests in the district, said they would be contented with a return of 7 or 8 per cent. on their money, considering that they ran grave risks. He did not blame the local authorities for not providing power, because he objected to local authorities engaging in trade.

At the request of Mr. Russell, Mr. Lloyd said that at Cardiff, at present, there were three customers taking over 20,000 units per annum, and in Newport one took 34,000 units, and two close on 20,000 units.

The Committee adjourned.

On the Committee resuming on Monday last week, Mr. Corbett, surveyor to the estate of Lord Bute, gave evidence as to the immense industrial works at Cardiff, most of which at present used steam power. Only the very large undertakings could afford to provide an electrical installation of their own, either for want of capital or want of room. He thought these works stood little chance of being supplied by the Corporation with electric current, and even should the Corporation meet the demand, he did not think they could do it as cheaply as that company. It had to be remembered that the Corporation was working with the ratepayers' money, and could not be so speculative as a company. He was a member of the Caerphilly District Council, which had petitioned in favour of the Bill.

In cross-examination, Witness said he considered it essential that the Bill should provide for lighting as well as power, and further, he thought the limited competition with local authorities provided for would be a wholesome stimulus.

Counsel representing local authorities proceeded to cross-examine witness as to the circular issued by the company over the district in favour of the Bill, but the Chairman pointed out that the Committee were bound by no such circular, and asked whether counsel considered it necessary to cross-examine on the matter at all.

In re-examination, Witness said that the ratepayers of Cardiff had recently refused to allow the Corporation to extend electric tramways into the outside areas.

Mr. Jennings, timber merchant, of Cardiff, and chairman of the Export Section of the Cardiff Chamber of Commerce, considered the Bill was of great importance to the timber trade in regard to their planing and saw mills. If they had an installation of their own there would be great waste, because their load varied so. If they could get electric power they would be able to greatly cheapen their insurance.

By Mr. Lloyd Lewis: He was not aware that the Cardiff Corporation had been offering to supply 4,000 units at 2d. a unit for power purposes, but he knew from the local press that they could not get enough current for lighting purposes.

By Mr. Ashcroft: If he could get electricity at 1d. per unit it would be only about one-third of what it cost him now.

Mr. W. Riley, another timber merchant of Cardiff, stated that owing to the lack of power he had had to give up the manufacture of window frames, &c., and now imported thousands from America.

By Mr. Ashcroft: He suggested that the electric lighting in Cardiff was inefficient and insufficient. He could not depend upon it.

Other evidence of a similar character was called, including the chairman of the Cardiff Chamber of Commerce, who said that the Bill had been carefully discussed by that body, and a unanimous resolution was carried in favour of it. They felt that if the company had to wait for the consent of the local authorities they would never get to work at all.

Mr. J. B. Ferries, ex-chairman of the Cardiff Chamber of Commerce, and connected with several large undertakings, said he was acquainted with what other countries had done in the way of supplying cheap electricity, and nothing had been done in England comparable to what had been done abroad. He did not think the local authorities could be expected to embark on such an industry as the supply of electricity for power purposes.

In cross-examination, Witness said he saw no reason why the company should not come in, even although another company had got power of supply from Parliament. He did not think the company should be compelled to buy up any existing electric lighting concern. Competition should be allowed, and the fittest would survive.

Replying to the Chairman, Witness said it was an impossible suggestion that there should be any distinction between the supply of electricity for lighting and power to collieries.

Mr Rees-Jones, of the Ocean Coal Company, gave similar evidence, and pointed out that if the supply of electric power was in the hands of the local authorities, his company would have to go to five local authorities to get power for their different collieries.

Mr. E. P. Martin, past president of the Iron and Steel Institute, and manager of the Dowlais Ironworks, employing many thousands of workpeople, said it was of vital importance that the industries of South Wales should get this supply of electric power, and he did not think they were likely to get it by means of the local authorities.

Sir John Gunn, manager of the Cardiff Railway Company, and director of several other undertakings, gave evidence of a similar character.

On Tuesday, Mr. Butler, of Messrs. Wright, Butler & Co., iron and steel manufacturers, gave evidence. He considered the supply given by local authorities hopelessly inadequate.

Mr. E. Daniell, manager director to Earl Cawdor and other gentlemen, described the industrial works in South Wales, and emphasised the great need there was for a scheme of the kind now proposed. If the western part of the district was struck out, it would be a great disadvantage.

Replying to the Chairman, Witness said Swansea had a population of 100,000, and around Neath and Britton Ferry there was a large population engaged in industrial occupation.

Mr. J. Glasbrook, of the firm of Glasbrook Bros., colliery owners, and amongst many other appointments a director of the Swansea Gas Company. He was also largely interested in the timber trade and the tin-plate trade in the Swansea district. He considered the scheme would be of the greatest benefit to the Swansea district. All the hauling and pumping work at collieries could be done by electricity—in fact, all the work except winding could be so done. The reason why they had not used electricity themselves was that the expense of installation was so great. In the village he resided they had to pump the meter supply by a gas engine, and if there was an electric main passing near, that work could be much better done by electricity. In many other directions there was a field for the use of electricity.

Mr. H. J. Waddy, connected with engineering works at Swansea, said they had generated electric current for themselves, but they had come to the conclusion that it would pay them better to get their power from a company if it was authorised. The reason was that they were bound to put down surplus power, and further, they had to find space. They would take something like 800,000 units per annum, and he thought there was little chance of the Swansea Corporation ever supplying it. The Swansea Corporation proposed an all-round charge for electricity of 3d. per Board of Trade unit, but they could make it cheaper themselves. He was opposed to the Swansea Corporation supplying power because the management of the electric supply would then be in the hands of the ratepayers, and they would prefer to take it from a private company in whose management they had confidence.

The Chairman at this point intimated that the Committee would not be affected by any more of this class of evidence.

Mr. Ram said he had a large number of similar witnesses, but would not call them.

Mr. Wm. Graham, of Barry Dock, was called, and stated that the local authority was opposing the scheme, but the ratepayers generally did not understand the question. The manufacturers were favourable to the scheme. He considered it undesirable that the local authority of Barry should undertake such a work.

Cross-examined: In respect to electricity he was in favour of unlimited competition with the local authorities.

Mr. Morris Deacon, civil engineer, gave evidence of the uses to which electricity could be used in mines. The power principally used was compressed air, and it was very wasteful. The cost to colliery owners to supply electricity for themselves would be considerable, but a large company like that suggested could produce electricity much cheaper. Large collieries could manufacture electricity perhaps as cheaply, but there would be the capital expenditure. He had no doubt whatever that the current supplied by the company would be largely used in the district, and in view of the severe American competition it was very necessary indeed that such facilities should be given to English manufacturers.

In cross-examination, Witness said it would pay colliery owners to take electricity at 1d. per unit.

Mr. Callender, manager director of the Callender Cable Company, said he had been engaged for 20 years in laying down cables. They had about 150 contracts running at the present. The solid system was the one almost entirely adopted. He had had experience of laying cables at Tyneside for colliery and other works, and they could lay cables such as he proposed to carry 20,000 volts with perfect safety. He saw no difficulty of carrying out the scheme now proposed, with proper mains.

In cross-examination, Witness said there would be no difficulty in laying cables in narrow streets.

By the Chairman: They had laid cables for many municipal authorities. The local authorities had no special knowledge of the laying of cables. It would cost from £1,300 to £1,500 per mile to lay cables. There had never been any demand for a cable in England to carry 20,000 volts, but it could be done with perfect safety.

By Mr. Ashcroft: It would be economical to carry current at 10,000 volts 30 or 40 miles in America, but it was not wanted in England. Further examined, Witness said 20 miles in England was certainly within the range of economical working. He thought the three generating stations proposed in the district would be sufficient.

Mr. Harris, engineer, partner of Sir Frederick Bramwell, said they had designed and carried out many electrical works in different parts of the country. He was engineer to the scheme. He had examined and reported on transmitting schemes in many countries, and had visited the station at Niagara. He desired to put before the Committee, as engineer for the Bill, a practical illustration of the cost of electricity for a day load, and knowing the Liverpool Overhead Railway very well, and that Mr. Cottrell, the engineer for that railway, had kept the cost very accurately from the first, he asked him to be a witness. Mr. Cottrell could not be there that day, but he had his proof before him. The Liverpool Overhead Railway Company produced its electrical power at a generating station at Moor Dock. He had the cost of the coal and the units generated from the half-year ending June, 1894, to the half-year ending December 31st last, and the cost ranged from ·55d. in the earlier years, when the generation was smaller than now, to ·301d. in the half-year ending December 31st, 1898. Since then it had gone up a little, owing to the increase in the price of coal. That was a load of practically 18 hours a day, and the total units generated in the half-year ending December 31st, 1899, was 2,168,034. He knew of no instance anywhere which would give a better illustration of the cost of electric generation. This included every item of cost, except what he would call purely company costs. The cost of the coal ranged from 5s. to 10s. a ton, but he was sorry to say that coal had gone up considerably in price that year. With regard to the area over which the company now proposed to work, he had known it intimately for years, and knew that industrial undertakings were largely increasing in the district. He considered that Neath and Swansea and the western portion of the county had as much need of this supply as the other portion of the county. He believed there were 11 stations now at work in the district, and 10 square miles, roughly speaking, were served. Last year the total number of customers were 965, and about 826,882 units were supplied. To illustrate the difficulties which surrounded the supply of electricity by local authorities, he would point out that in one case if they had an engine of 200 H.P. running continuously, it would supply the whole of the consumers for which the authorities had had to instal 2,488 I.H.P. The Bill provided for an I.H.P. of 30,000, but they appreciated that if they were successful they would in the future have to come to Parliament again for more money. There were about 1,800 collieries and works of various kinds in the district, and the promoters of the Bill were interested in about 40. Personally he did not think that municipalities ought to go in for that kind of trading, and he did not see how municipalities who were supplying electric light could supply the power, because he could not imagine any engineer putting down mains for light sufficiently large for power purposes. The company did not desire any monopoly, and they could not object if another company came in. They had tried to avoid interference with the municipalities, or otherwise there would have been no reason why they should trouble about distinguishing between wholesale and retail consumers. He took it that the Electric Lighting Acts would be sufficient to protect municipalities as regarded the breaking up of the streets.

By Mr. Bartley: Even if the local authorities combined together with their present business waste must follow.

By Mr. Bonham Carter (Referee): The extreme distance to which they would carry electricity was about 12 miles. Most of it would be served in an area of six or seven miles from each station. He hoped that they would have 30,000 H.P. installed in five years.

On Wednesday last week Mr. Balfour Browne, Q.C., addressed the Committee on behalf of the Cardiff, Swansea, Newport, and Barry local authorities, and said that Mr. Pember had stated that this Bill was different to those which had already been considered. It was different—he thought it was the worst of them, and was certainly a most unfair Bill. He thought the promoters had been guilty of a breach of faith in respect to the undertaking which had been given by Mr. Ritchie in the House of Commons. When the question came up before the House, Mr. Maclean, the member for Cardiff, asked "whether the written undertaking of the Lancashire promoters to do nothing without the consent of the local authorities would also apply to the South Wales Bill, which in its present form empowered the promoters to supply wholesale customers—that is to say, to pick the plums out of the pudding without the consent of the local authorities," and Mr. Ritchie said, "Unless the promoters of this Bill are willing to accept a provision of the kind, I at least should not be prepared to vote for the second reading."

The Chairman: You accuse them of a breach of faith. That is not a declaration of the promoters of the Bill. The undertaking was the undertaking of the Lancashire promoters.

Mr. Balfour Browne: Mr. Ritchie was pledging them.

Mr. Benn: He knew nothing of it.

Mr. Balfour Browne, continuing, said that if it was not right to allow a municipality to compete with a company, it was worse to allow a company to compete with a municipality if the municipality was doing its duty, and he contended that both Cardiff and Newport were at present doing their duty satisfactorily to their consumers. Swansea also had now got power and was spending money to meet the wishes of its own consumers, and he asked the Committee to say that neither of these local authorities should be competed with by the company. It had been the universal practice of Parliament to allow no competition with the local authorities where they were doing their duty, and in these cases there had been no *laches*. As to Barry, they had not an electric supply at present, but it was a young and growing town. If the Bill was passed they would lose their rights under Section 36 of the Electric Lighting Act altogether.

An argument took place between counsel as to the meaning of the clauses of the Bill dealing with the company's right to supply electricity for lighting in local areas, and the Committee conferred in private on the matter.

On resuming, the Chairman said the Committee considered that

the time had arrived when it would be convenient for them to make the following declaration:—"A local authority which undertakes and is prepared to give a full and adequate supply of electrical energy for all purposes to consumers within its district ought not, without its consent, to be required to give facilities for the supply within its district of electric energy by other undertakers, but if the local authority is unable or unwilling to provide on reasonable terms and within a reasonable time full and adequate supply of electrical energy for any purpose to any company or person applying for the same within its district, such company or person should be at liberty, after notice to the local authority, to obtain their supply from other authorised undertakers, and the local authority should be required to give all reasonable facilities for the purpose. Any difference arising out of any of the above questions shall be the subject of arbitration as provided by the general Act." Of course, they would see that that over-rides Clause 36 of the promoters Bill which would give the promoters the right to supply persons who undertook to take not less than 20,000 units a year.

Mr. WEBBERBURN suggested that they might adjourn till the following morning so that it might be considered how far the decision met the opposition.

Mr. PEMBER said he would have to ask one or two questions as to the meaning of the decision.

The Committee decided to adjourn till 3 o'clock in the afternoon.

Mr. PEMBER, on resuming, said he had looked at the decision, and he need not tell the Committee that it was a matter of very great importance as to what the ultimate effect would be, for it was a question of whether £1,000,000 was worth finding or not, or whether the Bill with such a clause was worth the acceptance of the promoters as representing the trade of South Wales. He would like to know what was the real meaning of "undertaking." It was somewhat vague, and unless some definition was arrived at, it would be almost impossible for any arbitrator to make up his mind as to what a proper "undertaking to give" was. Then the words "full and adequate supply" was extremely vague, and also the words "reasonable terms." Did the terms include price and the conditions under which electricity was supplied? No doubt it was known to them that there were different systems of electric supply. He asked himself what were reasonable terms, and what was a reasonable time. As he understood the decision, every person, before being able to take a supply from his company, would have to go before an arbitrator. The customers would have to take the initiative, and it was obvious that they could not ask customers to do that. And again, it would be a recurring arbitration, because conditions changed from day to day. He was never placed in such a difficulty before.

The CHAIRMAN asked if the usual course would not be for the promoters to frame clauses and submit them to the Committee.

Mr. BALFOUR BROWNE said it could be easily put in the form of a clause which would be understandable.

The CHAIRMAN: I invite consultation.

Mr. PEMBER said it was no good him preparing clauses unless he knew that the preamble of the Bill was proved.

Mr. BALFOUR BROWNE said he was perfectly prepared to close his case on that declaration of the Committee.

Mr. SHAW said he represented the Penarth Electric Lighting Company which existed with the consent of the local authority, and the decision said nothing about existing companies.

Mr. RIGG, representing the Pontypool Electric Lighting Company, said he was in the same position as Mr. Shaw. If that company came in and supplied electricity at a cheap rate it would ruin his company. He asked that his company should be placed in the same position as a local authority.

The CHAIRMAN pointed out that the local authority would have to consent to another company coming in.

Mr. RIGG: But the local authority for its own purpose might consent to another company coming in.

Mr. PEMBER said neither the Board of Trade nor Parliament would consent to any clause in a Bill disallowing another company to come in. He did not think he ought to be called upon to discuss a clause before he knew whether he had got the preamble. He thought the best way would be to proceed with the opposition of the existing lighting company, who clearly had the right to be heard.

Mr. BALFOUR BROWNE: I am quite willing on this decision being fairly carried out not to oppose the preamble.

Counsel representing other local authorities intimated that they would follow the line taken by Mr. Balfour Browne.

Mr. SHAW said that if the same protection was given to the existing companies as to the local authorities it would content him.

Mr. PEMBER: I would not take a Bill with such a clause in it.

Mr. BILSTON, M.P., pointed out that there were only two such existing companies—Penarth and Pontypool—and he asked Mr. Pember if he could not arrange with them.

Mr. PEMBER: Certainly not.

Mr. RIGG then called Mr. WALKINS, the secretary of the Pontypool Electric Lighting Company, Limited, who detailed the operations of his company, and stated that it had fully carried out its responsibilities.

Mr. SHAW also called evidence of a similar character for the Penarth Electric Lighting Company, which had a capital of £50,000, and was spending it as fast as they could.

Mr. SHAW argued that a great principle was involved in the opposition of the companies, because the Committee were being asked to allow a company to come in and supply broadcast.

On Thursday last week Mr. WEDDERBURN addressed the Committee on behalf of the district of Tredegar and Ebbenvele, part of whole districts were scheduled and part not. With respect to the circular sent round by the company to local authorities, he pointed out that local authorities had not petitioned against the Bill, because that circular stated that there would be no competition in municipal lighting. He asked the Committee to carry out the terms of the circular if they passed the preamble and allow no such competition in municipal lighting.

The Committee's Decision on all the Bills.

The CHAIRMAN, after the Committee had conferred in private, said: "I have to announce that the Committee is of opinion that subject to the principles contained in their declarations being embodied in clauses to be approved and subject to additions and amendments in clauses, as on going through the clauses of the Bill appears necessary, the preamble of the South Wales Electric Supply Bill is approved. It may be convenient, although the business is not down to-day, to announce also that the preamble of the Durham Electric Power Supply Company's Bill is proved; that the preamble of the Tyneside Bill is not proved to the satisfaction of the Committee; that the preamble of the Lancashire Electric Power Bill is proved to the satisfaction of the Committee. The intention of the Committee is to insert as far as may be applicable, the same conditions in each of the Bills."

It was then agreed to take the clauses in the South Wales Bills on Tuesday.

ELECTRIC POWERS BILL.

ON assembling on Tuesday, the Committee deliberated in private for about two hours, and when the public were admitted the CHAIRMAN said: The statement that I have to make now is an expansion of the declaration of the Committee which has already been given to you on the South Wales Bill. It is as follows:—(1) The company to be authorised to supply electrical energy for power purposes anywhere within the area of supply, subject to the consent of the local authority in certain cases, as set out below. (2) The company to have no general lighting powers, *i.e.*, distribution to ordinary consumers within the area, except in pursuance of a provisional order obtained in the ordinary way. (3) Where a local authority is now authorised to supply electricity within the area, their consent is to be required for the supply of electricity by the company, the Board of Trade to be empowered to override the refusal of the local authority to give consent if the authority are not prepared to provide the requisite supply on reasonable terms and within a reasonable time. (4) Any local authority who hereafter gets statutory powers for supplying electricity within the area, to have, in ordinary cases, the option of taking over the company's supply in its local area on terms to be laid down by the provisional order or Act by which the statutory powers are given. (5) A company having statutory powers to be in the same position as a local authority now having statutory powers; a company to whom powers are hereafter granted to be placed in the same position as a local authority to whom statutory powers are hereafter granted. That is the decision of the Committee, and it is suggested that the Government draughtsman, Mr. Thring, should meet the agents and go through the clauses. The Committee will meet to-morrow at 12 o'clock, in the hope of finally settling those clauses.

The agent for the Lancashire Bill said he did not think there was anything in the Committee's declaration which would apply to the Lancashire Bill.

The CHAIRMAN: We have made no declaration on the Lancashire Bill, because it is not affected by these provisions.

The Committee then adjourned.

ELECTRIC LIGHTING IN THE ISLE OF WIGHT.

ON Tuesday last week the Select Committee of the House of Commons, presided over by Sir A. Gobson, met to consider Bills to confirm provisional orders granted by the Board of Trade under the Electric Lighting Acts, 1882 and 1888. The first Bill to be considered was an order of the Board of Trade for the formation of a company to supply electric light in Freshwater, Totland Bay, and Yarmouth, Isle of Wight. It was opposed by the rural district of the island for whom Mr. Wedderburn, Q.C., appeared. Mr. Rigg appeared for the promoters, and called

Mr. CHARLES EDMONDS, a solicitor of Yarmouth, one of the directors of the company, who said he was acting as secretary, *pro. tem.* There was no system of lighting in the district except that supplied by a small gas works that lit Yarmouth. The population of the place was 4,000, and the rateable value from £18,000 to £20,000. There were eight hotels in the district. The capital of the proposed company was £15,000 with borrowing powers up to one-third of the amount, and there were five directors, all of whom were gentlemen resident in and interested in the district. They had promises of shares being taken up to £2,000.

Mr. HARRY LEE, house agent, of Freshwater, and Mr. F. CHRISTY, electrical engineer of the firm of Christy Bros., Chelmsford, gave evidence bearing on the electrical equipment of the company. They had a site close to the station from which they would have a siding on the railway, and they had an excellent supply of water. They proposed to put down a plant which would work 3,000 8-C.P. lamps at a cost of £10,000. They estimated that they would be able to get customers for 1,200 or 1,500 lamps the first year, which would bear the whole expense and leave a small margin of profit. When the consumption increased to 3,000 lamps the company would be able to pay a dividend of 5 per cent. At the expenditure of an additional £5,000 they would be able to double the producing power of the plant and be able to pay dividends of 10 per cent. It was proposed to charge 7d. per Board of Trade unit for the light, which was not more than the

usual price for towns of that kind. The period of purchase was 42 years, which had been granted by the Board of Trade, and which was the maximum period.

Mr. Wedderburn addressed the Committee in opposition to the Bill, and said that the local authority was in a different position from what it was when the Bill was promoted. At that time Freshwater was a rural district, but now they were about to obtain the powers of an urban district council, and they would be able to obtain a loan from the Local Government Board to promote an undertaking of their own. They asked that the period of purchase should be reduced to 21 years; that the price charged should be 5d. instead of 7d. per unit, and that they should have some better security that the company were going to proceed with the works than the £500 which the Board of Trade required.

The Committee passed the preamble of the Bill, but reduced the period for the purchase by the local authority to 21 years, with a premium of 15 per cent. upon the value; 28 years with a premium of 10 per cent., and 35 years with a premium of 5 per cent.

Morley Corporation Bill.

On Thursday last week, before Lord Morley's Committee of the House of Lords, the Omnibus Bill of the Morley Corporation came on as an unopposed measure. The only matter before the Committee was the redrafting of Clause 9, dealing with contracts for the supply of electricity. Mr. Pritchard (Parliamentary agent) brought up a new clause, the effect being to empower the Corporation to make agreements with authorities, companies, or persons authorised to supply electricity in bulk to outside districts for the purpose of light railways, tramways, &c. There was a proviso that the Corporation should not supply electricity in bulk in any outside district where there was an authority, company, or person authorised to supply electric energy, without the consent of such authority, company, or person.

This clause was inserted in the Bill.

Lord Morley also intimated that Clause 7 (notice of discontinuance of supply), and Clause 10 (power of the Corporation to supply electricity in adjoining districts) would have to come out, and model clauses would be substituted.

The alterations were made, and the Chairman stated that the new Clause 9 would have to be approved by the Board of Trade, and accordingly the report stage had to be postponed.

Wellingborough Tramways.

Lord Fermanagh's Committee was engaged for several days last week in considering the Bill promoted by the British Electric Traction Company for constructing tramways in Wellingborough and district. The proposal was to make a line beginning at Wellingborough, through Irchester, Rushton, Higham Ferrers, Rounds, Irthlingborough, and Finedon, back to Wellingborough. The length of the tramways would be about 20 miles, and the cost would be about £136,000. There were proposals in the Bill to run into the stations of the railway companies in the district, and also to pass over a level crossing on the London and North-Western Railway. To these proposals, Mr. Littler, Q.C., on behalf of the London and North-Western Railway, strongly objected, although the company were not opposed to the scheme otherwise.

The Committee decided to pass the preamble of the Bill, but disallowed that portion of it which would enable the tramway company to have access to the stations of the London and North-Western Railway.

Cambourne and Redruth Tramways.

The Select Committee of the House of Lords, presided over by the Duke of Northumberland, considered on Wednesday and Thursday last week the Cambourne and Redruth Tramways Bill. Mr. Erskin Pollock explained for the promoters that the order was one authorising the Urban District Supply Company to construct a tramway in Cambourne, Redruth and Illogan. The total length of the tramway would be 3 miles 3 furlongs, and the gauge was to be 3 feet 6 inches. The only opponents were the Great Western Railway Company, who considered that the tramway, if constructed, would interfere with the safe and efficient working of several of their branches.

Considerable local evidence was called in support of the scheme, and Mr. Gripper, of Edmundson's Electricity Corporation, said his company had satisfied the Board of Trade in respect of their financial ability to carry out the scheme, and they proposed to work the tramway in connection with their electrical station at Redruth. This arrangement, by which one station would supply both the current for electric lighting, and also for the motive power of the tramway, would be an economical one. He estimated the outlay would be £20,000 to £30,000.

Mr. Walter Hopkins, C.E., of George Hopkins & Sons, the engineers, said the line had been stopped at Redruth at the point selected in order that the streets might be avoided which the Light Railway Commission had formerly objected to. The road was a suitable one for a tramway. They proposed to give a quarter of an hour to 10 minutes' service, according to the amount of traffic. There had been no difficulty with the frontagers; on the contrary, nearly all of them had petitioned in favour of the Bill.

The Committee found the preamble of the Bill proved, and it was ordered to proceed.

Liverpool Corporation Bill.

The Liverpool Corporation Bill, which gives borrowing powers for street improvements in connection with the electric tramways, &c., came before a Committee of the House of Lords on Thursday last week, as an unopposed measure, and was ordered to be reported.

Tramways at Bootle and St. Helens.

On Wednesday last week the Provisional Order Bill confirming powers granted by the Board of Trade to the Bootle Corporation, the Radcliffe Urban District Council and the St. Helens Corporation for the construction of tramways in those districts, was before the House of Lords Committee. It was intimated that all opposition was withdrawn, and the Bill will accordingly go forward as an unopposed measure.

West Ham Corporation Bill.

Mr. R. McKenna's Select Committee of the House of Commons had before it on Thursday last week the above Bill which, amongst other things, asked for power to reconstruct and work electrically certain tramways within the borough, and also to enlarge the generating station. The total cost of the scheme was stated to be about £900,000. Part of the tramways are at present owned by the North Metropolitan Tramway Company, to which the Corporation has given notice of intention to purchase, the price to be decided by arbitration. It is proposed to use the overhead system of electric traction.

The Committee passed the portion of the Bill dealing with tramways.

Gosforth Electric Lighting.

The Gosforth Provisional Order was granted to the Newcastle-on-Tyne Electric Supply Company, authorising them to supply electricity in the district of Gosforth. Mr. Moon and Mr. Shortt appeared for the promoters, and Mr. Pember, Q.C., and Mr. Haus Hamilton for the Corporation of Newcastle, who were the only opponents. The allegation of the Corporation was that the present generating station was in a very inconvenient position, and that any addition to it would be against the interests of the inhabitants. They also objected to the interference with the streets which the carrying of the mains to Gosforth would involve.

After hearing ended the Corporation withdrew their opposition on condition that a clause was inserted protecting their interests in the City.

Batley Corporation Tramways.

A Select Committee of the House of Lords, presided over by the Duke of Northumberland, considered on Wednesday and Thursday last week the consideration of the Tramways Provisional Order Confirmation Bill, which included the scheme of the Batley Corporation for the construction of an electric tramway through their district. The promoters were represented by Mr. Fitzgerald, Q.C., and Mr. Williams, and the opponents, who were the British Electric Traction Company, were represented by Mr. Freeman, Q.C.

Mr. Fitzgerald, Q.C., in opening the case, said that a steam tramway owned by a private company already ran through the district, but under the Tramways Act so much of the line as was within the borough would be acquired by the Corporation. There was no local opposition to the proposed tramway. The British Electric Traction Company, which was opposing, had obtained a provisional order from the Light Railway Commissioners for the construction of the Spen Valley Light Railway, which was intended mainly for passenger traffic, but he believed the Board of Trade had not yet confirmed the order. The Corporation had gone before the Board of Trade for their provisional order, and the British Electric Traction Company objected to the order being granted, but the Board of Trade granted the order, and he now asked the Committee to confirm it. There would be a clause in the present Act which would entirely safeguard the Spen Valley Light Railway in case their order was eventually confirmed, for they would have running powers over the Batley Corporation Tramways. He argued that the schemes of the British Electric Traction Company were in an inchoate state.

Evidence having been given for the promoters, Mr. Freeman called Mr. S. Sellon, the engineer to the Spen Valley scheme, who said that the light railway would start at Dewsbury, and run through Heckmondwike to Cleckheaton, taking in the small portion of Batley, known as Halifax Road. It was an important scheme connecting up the district, which was now without any railway accommodation. The company were first in the field, and their scheme was sanctioned by the Light Railway Commissioners against the opposition of the Corporation of Batley. He regarded the Batley scheme as a counter move to their scheme, because the company's scheme had been sanctioned by the Light Railway Commissioners.

Mr. Sidney Morse, solicitor to the British Electric Traction Company, stated that owing to the Bill coming on earlier than expected, the witnesses for the opposition were not in attendance.

The Chairman announced that the Committee found the preamble of the Bill proved, but the clauses would have to be modified so as to make it quite clear that the Corporation should not be able to impede unduly the exercise of the company's rights over the line.

Weston-super-Mare Tramways.

A Select Committee of the House of Commons, presided over by Mr. D. Tatton Egerton, considered on Wednesday and Thursday last week the Bill confirming the provisional order granted by the Board of Trade to the Weston-super-Mare and District Electric Supply Company, authorising the construction of some three miles of tramways to be worked by electricity in the Urban District of Weston-super-Mare, at a cost of £30,000. The only opposition was that of the American Commercial Cable Company, whose objection was that the electric current that would escape from the tramway would prevent them from reading their delicate instruments at their cable station.

Mr. J. C. E. Graham, dealing with the opposition, said the whole question had been considered by the Committee of both Houses in 1893 in the case of the telephone companies, who had it proved to their satisfaction that the use of insulated returns by telephone companies would prevent all interference from electric tramways. In the case of cables at Coney Island and Cape Town, means had been adopted by the cable companies which obviated all interference from tramway currents, and these might be adopted in the present case.

Mr. Sellon was called for the promoters, and said the cable company could protect itself against those leakages by having a twin-core cable run for several miles out to sea.

Other evidence having been called for the promoters, Mr. Geo. Ward, vice-president of the Commercial Cable Company, gave evidence against the Bill, and contended that as his company was at Weston-super-Mare first, the tramway company ought to pay for any protection necessary for the cable.

Mr. Gott (electrician to the Cable Company) and Mr. H. A. C. Saunders (electrician to the Eastern Telegraph Company) also gave evidence as to the disturbance which would be caused to the cable, the former gentleman stating that it would cost £600 a mile to lay a twin-core cable to obviate this disturbance.

On Thursday, Mr. Swinburne, consulting engineer, stated that experience had shown that disturbance did arise from those tramway currents, and it would be a serious thing for the company to take their return circuit four or five miles out.

Prof. Ayrton was also called for the opposition, and said he thought the tramway could be so constructed with insulated returns that there would be no risk of disturbance.

On Friday the decision of the Committee was announced as follows:—"The Committee have taken a little time to consider the question, because it is one of grave import. The question arose as to whether a precedent ought to be established either for or against the report of the Joint Committee of 1893 in connection with the working of tramways. The Committee have decided to pass the Bill subject to the insertion of a clause such as this—'This Act shall not be construed so as to prejudice or interfere with any rights which the Commercial Cable Company may, by any court of law, be held to possess under the common law, either statute or otherwise, in regard to the uninterrupted user, or enjoyment of their submarine telegraph cable running to Weston, provided always that the recommendations of the Joint Committee of 1893 in regard to the laying of electric tramways be carried out so far as they are applicable to submarine cables.'"

In reply to Mr. Balfour Browne, Q.C., the Chairman said the Committee wished to leave the Cable Company in possession of every right they now possessed.

Mr. Balfour Browne promised to bring up a clause carrying out the decision of the Committee.

On Monday this Bill again came before the Committee, when Mr. Balfour Browne, for the promoters, said they would accept the clause as drafted by the Committee.

The Chairman said the Committee desired to strike out the reference to the report of the Joint Committee, as they could not say whether a cable company were or were not under the provisions of the recommendations of that Committee, and in the event of litigation, they did not wish the tramway company to be able to plead statutory powers. They would report to the House that the question of the decision of cable companies in regard to electrical enterprise had been brought before them, and that they had refused to decide the point. They would also recommend that the question should be considered by the Committee of the House.

The clause amended was then added to the Bill, and it was ordered to be reported.

Brighton Tramways.

The Bill promoted by the Brighton Corporation, containing, amongst other things, power to construct and work tramways, came before Lord Morley's Committee of the House of Lords on Friday last, and passed as an unopposed measure.

Municipal Trading.

At the sitting of the Joint Committee on Municipal Trading on Friday last, Mr. W. G. Floyd, ratepayers' auditor for the City of Birmingham, gave evidence as to calling for particulars of accounts in connection with certain purchases of land and the water scheme some years ago. He was refused all documents other than the formal receipts by the city treasurer, under the advice of the town clerk. His contention was that he ought to have been furnished with all documents. He made no charge against the honesty of councillors, but only charged them with reckless expenditure. After fighting the Corporation, they eventually produced the accounts asked for. He thought in the interests of the ratepayers the Government should appoint auditors in all cities whether great or small.

By Mr. Hobhouse: He thought there was a large body of public opinion in Birmingham against municipal trading.

Mr. E. A. Smith, town clerk of Birmingham, referring to the last witness's evidence, said that Mr. Floyd was appointed hon. sec. of a ratepayers' association, since deceased, and he applied for the documents before he was elected auditor. Mr. Floyd wished to get information for the Ratepayers' Association which would certainly have been prejudicial to the interests of the ratepayers. With regard to the general question of municipal trading, his Corporation undertook a great many municipal functions, including water, gas, and the electric supply. They had not got the tramways yet, but when the leases of the company ran out he expected the Corporation would take them over. He considered that such things as he had mentioned came under the head of municipal trading, and should be in the hands of his municipality, but there were some proposals for municipal trading which he did not approve of. He considered that it would be extremely difficult to put a limit to municipal enterprise, and each town must be treated on its own merits, because needs and circumstances greatly differed, and one Corporation might be trusted with powers which it would be hardly wise to give to another. He was against auditing by a Local Government Board auditor on the ground of friction.

The Committee adjourned.

At Tuesday's sitting of the Committee evidence was given by Sir Thomas Hughes, J.P., of Liverpool Corporation, and Alderman Southern, of Manchester.

Rotherham Tramways.

The Rotherham Provisional Order Confirmation Bill was before Sir F. Godson's House of Commons Committee on Monday. The Bill is an omnibus Bill, and deals with the working of tramways, amongst other matters. The only opposition was with respect to the water proposals contained in the Bill, and evidence having been called, the Committee found the Bill proved, and ordered it to be reported to the House.

Hull Tramways.

On Thursday last week the Select Committee of the House of Lords, presided over by the Duke of Northumberland, considered a Bill for confirming the city of Hull provisional order. The Bill authorises the Corporation to reconstruct and apply electric traction to the Hedon Road steam tramways, and to extend them to Marfleet Lane. It also proposes the extension of the existing section of the electric systems to the Holderness Road from the present terminus at the East Park to a point just within the city boundary, and a construction of the Prospect Street section. The petitioners against the Bill was the North-Eastern Railway Company, who objected to the tramways going along certain roads over which they had an easement.

Mr. Balfour Browne, Q.C., for the promoters, contended that the railway company was even more amply protected than they had the right to expect.

The Town Clerk, of Hull, was called and stated that the electric tramways now in the hands of the Corporation had proved a great success financially, and the Hedon Road section, which was what the railway objected to, had been bought by the Corporation so as to have all the tramways on one complete system.

Mr. W. H. Wellsted, C.E., who was the engineer for the existing steam tramway in Hedon Road, stated that no accidents had arisen in connection with the level crossings with the steam trams, and he considered there would be much more command over the electric tramcars.

Mr. S. Sellon was called as an expert witness, and stated that in the various schemes in which he was interested, there had never been an accident where the tramway crossed the railway. There was no difficulty in putting a double line across the existing railway at Hedon Road, and danger could be avoided by the Board of Trade block system and catch points. There was no danger to the public by the use of electric traction for the crossing in question, because it was under proper control.

In cross-examination, Witness said that, of course, if there were not other interests to consider, a bridge would be better than a level crossing, but a bridge over the railway would entail hardship on the road traffic.

Replying to the Chairman, Counsel for the Corporation said that their case was that it was the railway company who ought to put the bridge up to carry their traffic over the roadway.

On Friday, Mr. A. E. White, city engineer, was called, and stated that a road bridge over the railway would be disastrous to the heavy traffic on the road, and there was also a grave objection to subways.

Mr. Moon, addressing the Committee for the North-Eastern Railway Company, said that company had not opposed the Corporation power to run electric cars over the other crossings, and now they were sorry they had not done so, because their experience was that there had been a greater number of mishaps. He did not think that any lives had been lost, but that was only a matter of time. That they were anxious to avoid, but had to remember in that case the road where the electric tramways were to go had been hitherto crossed by steam tramways, and there had been no accident at Hull,

neither had there been one at Stockton where steam trams ran, but both at Stockton and at Hull, where steam had ceased and electricity had been substituted, accidents had happened. What petitioners asked the Committee to do was to say that these crossings ought to be got rid of and that the North-Eastern ought not to get rid of it at the expense of the Corporation, but that it being a town's improvement the Corporation ought to contribute to it.

The Chairman, in giving the decision of the Committee, said that the Committee did not see their way to granting electricity or a double line at the crossing in question, and they did not see their way to pass so much of the Bill as referred to that. In their opinion, before such a proposal could be entertained some definite proposal should be made of a give-and-take system as to lowering of roads or raising of railways berore Parliament should be asked to give the powers asked for.

The Bill stood over for a meeting between the parties interested.

On Monday, Mr. Pember said that there was every reason to believe that a compromise would be arrived at between the Corporation and the Railway Company with reference to the level crossing at Hedon Road, and that in all likelihood it would be arranged to carry the tramway under the railway—the railway being raised and the road lowered. Such an agreement could not, however, be carried out till Thursday, when the Town Council met, and he suggested that the Committee might empower the Chairman to pass the requisite clause if the Committee had concluded its labour.

The Chairman said that the draft clause might be submitted to the Committee before it rose, and this was agreed upon.

On Tuesday Mr. H. Lloyd, for the promoters, submitted the clause which was the subject of discussion on the previous day. It was to the effect that the tramway should not be laid or electrical power employed on that part of the Hedon Road where it crossed the railway, unless the railway was carried over a bridge, as arranged between the parties. The railway company was to seek powers in the next Session to carry out the works, and the Corporation was to assist them in obtaining such powers.

The Chairman said it must be understood that the Corporation must either take the clause or leave it, as he would not be responsible for alterations.

Garston Tramways.

The House of Lords Committee, presided over by the Duke of Northumberland, on Tuesday considered the Bill confirming the provisional order for the construction of two miles of tramway through part of Garston by a private company. It was intended after the company had constructed the tramways that they should be sold to the Garston Urban District Council, although to save the Council the necessity of raising money at this time the actual payment would be deferred for 21 years. In the meantime the tramways were to be leased to the company for the period at an annual rental of £300. The Committee decided to pass the portion of the Bill relating to the Garston tramways, subject to the insertion of a clause to the effect that the amount which the Corporation should eventually pay to the company would be reduced by £300 a year for 21 years.

Warrington Tramways.

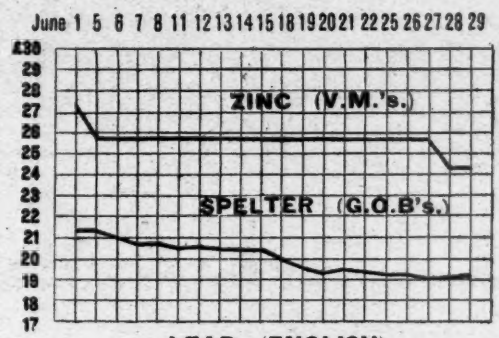
A Select Committee of the House of Lords, with the Duke of Northumberland as Chairman, considered on Tuesday the Bill to confirm a provisional order authorising the Warrington Corporation to construct a system of electric tramways. Mr. Ram, Q.C., and Mr. Hutchinson, appeared for the promoters, Mr. Moon representing the London and North-Western Railway in opposition to the Bill.

Mr. Ram explained that the object which the Corporation had in view in obtaining their provisional order was to construct a system of electric tramways within the borough. A very great need existed for a service of tramcars in the town, and several attempts had been made to provide a system, but so far without success. The Corporation had now come to the conclusion that the time had arrived when, as the principal local authority, they should move in the matter. Generally speaking, there was a remarkable absence of hostility to the Bill, the only opposition being that of the London and North-Western Railway, who objected to the tramway crossing the level on one of their lines. The Corporation admitted the necessity of adequately meeting the objection, and if it was considered necessary to erect a bridge, they would be prepared to pay their fair share of the cost.

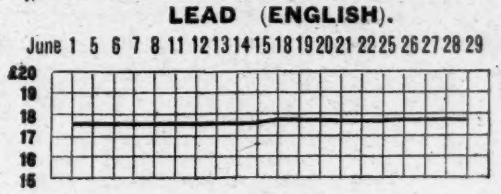
Mr. Moon having addressed the Committee on this point, the Chairman said the Committee had decided to pass the Bill subject to the proviso that if the Board of Trade should order a bridge to be erected the Corporation should contribute half the cost.

Telpher Systems. — The Consolidated Telpherage Company, of New York, have sent us a number of leaflets in which they describe their telpher system for coal conveying, and for mail carrying overhead or underground; another circular shows their electric tubular dispatch. Some interesting little sketches shows the method of preparing the trenches and laying the pipes therein. The system is a modification of the original one, worked out by Profs. Jenkin, Ayrton and Perry years ago.

METAL MARKET.—Fluctuations in June.



LEAD (ENGLISH).



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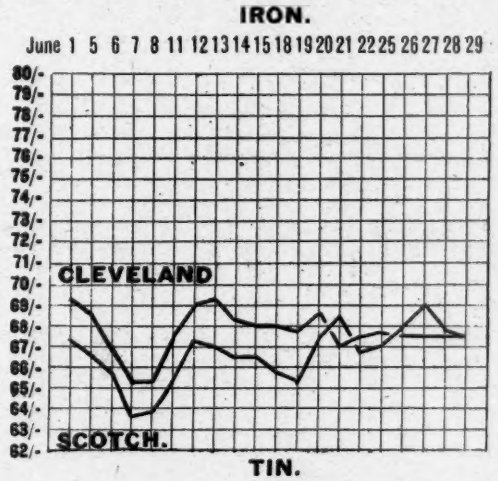

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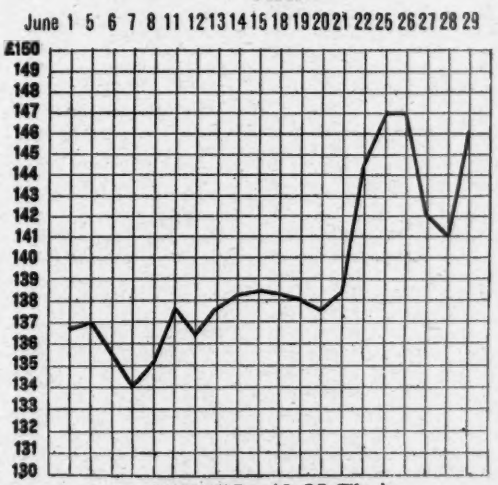
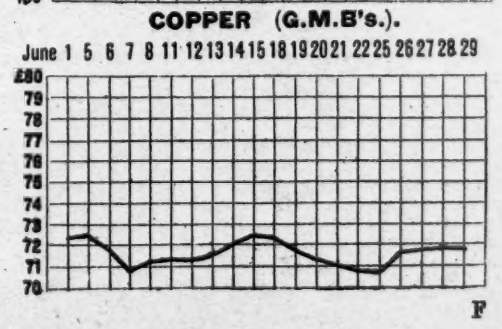


COPPER (G.M.B's.).



LEGAL.

Corporation of the City of Dublin *v.* The Dublin United Tramway Company.

The facts of this case, which involved the discussion of an important question relating to the liability of an electric tramway company to cast sand upon their track, were shortly reported in our issue for June 15th, 1900, at p. 1011.

The company were charged under the 21 Vic. c. 43 with making default in maintaining and keeping in good condition and repair their portion of the said streets, so as not to be a danger or annoyance to the ordinary traffic, thereby rendering themselves liable to a penalty not exceeding £5 per day during such continuance. They were also charged with the same offence on August 4th, 1899. Mr. Swifte had convicted and ordered defendants to pay a fine of £5 and £10 costs under Section 37 of the Dublin United Tramways (Electrical Power) Act, 1897. He had also found that the proper remedy for the slipperiness complained of was the sanding of the tram tracks. The cost of such sanding was not less than £2,000 per annum.

The respondents appealed from this decision to the Queen's Bench Division in Dublin. The following questions were submitted to the judges on appeal:—

(1) Had the magistrate jurisdiction to adjudicate on the summons? (2) If so, was he right in deciding that, on the facts as found by him, the defendants were guilty of the offence charged, by having failed to comply with the provisions of Section 37 of the Dublin United Tramways (Electrical Power) Act, 1897, including therein the incorporated Section 28 of the Tramways Act, 1870? (3) Assuming the two previous questions to be answered in the affirmative, was the magistrate wrong in disregarding the evidence of the Chairman of the defendant company? (4) If so, was the error on the facts stated a material one?

Mr. Ronan, Q.C., Mr. Gordon, Q.C., and Mr. Murphy appeared for the appellants. Mr. MacDermot, Q.C., Mr. O'Shaughnessy, Q.C., and Mr. Philip O'C. White for the respondents.

Mr. Justice Madden, in delivering the judgment of the majority of the Court, said the obligation cast on the tramway company by the Act of 1897 was obviously a duty with regard to the general public. Was a pavement that, in certain weather, became so slippery as to be a danger and annoyance to the ordinary traffic maintained in conformity with the statute, which provided that the tram tracks should at all times be maintained and kept in good condition so as not to be an annoyance and a danger to the ordinary traffic? So long as the roadway was a danger to themselves the tramway company sanded it, but when it only became a danger to the public they ceased to sand it. The section seemed to be for the protection of the public. He was of opinion that both convictions of the magistrate should be affirmed.

Mr. Justice Andrews thought the evidence of the Chairman of the company was admissible, but as the magistrate said it would not have affected his findings, his disregard of it was immaterial.

The Lord Chief Baron concurred.

Mr. Justice Boyd dissented. He reviewed the Acts regulating the construction and maintenance of tramways in the city of Dublin, and held that the obligations cast on the company by these Acts had reference only to the fabric of the roads. It was not contended in this case that the company had not constructed their lines in strict conformity with the statutes, or that they had not kept them in good repair. The words in Section 37 of the Act of 1897, "shall maintain in good order and repair, &c., so as not to be a danger or annoyance to the ordinary traffic," referred, according to his construction, to structural works, wires, tubes, and electrical apparatus. The work which the Corporation could compel the company to do should be constructive work, and nothing else. He thought it was to be regretted that the Corporation did not adopt the alternative provided by the section of the Act, and do whatever work was necessary, and then sue the company for the cost. Had they done so the matter could be taken to a higher court, but under the course that had been taken, there could be no appeal from the decision of the Queen's Bench. He was of opinion that the conviction should be set aside.

The conviction was accordingly confirmed, and the tramway company were ordered to pay costs.

Berry, Harrison & Co. *v.* Lockwood.

In the Queen's Bench Division of Justice on Friday, before Mr. Justice Bruce and a common jury, the case of Berry, Harrison and Co. *v.* Lockwood came on for hearing. Mr. Frank Dodd and Mr. Oddy were counsel for plaintiffs, and Mr. Witt, Q.C., and Mr. Parsons for the defendants.

Mr. Dodd said the action was brought by Messrs. Berry, Harrison & Co., electrical engineers, of Lyric Chambers, Whitcombe Street, to recover £172, balance of an account for work done for the defendant at the Garrick Theatre in December last. It appeared that the defendant was sub-lessee of the Garrick Theatre, and in December of last year he was preparing to produce the pantomime of "Puss in Boots." In one of the scenes a good deal of electric lighting—some 2,000 lamps—was required, and the plaintiffs carried it out and put in the necessary fittings. There was a good deal of work to be done, and the requirements of the County Council, the Charing Cross Electricity Supply Company, and the insurance companies had all to be complied with. The work, which was carried out by Mr. Berry, was essential to the proper production of the scene, and it was done on the orders of the defendant and of Mr. Nash, his stage manager. If the work had not been done and the various requirements he had mentioned not complied with there would have been no pantomime.

For the defence the point was raised that the charges were excessive, but he would prove that the expense for labour had been increased owing to the defendant frequently requiring the stage for rehearsals and interfering with the work. As to the material and fittings, the plaintiffs had not charged the full list prices. There was another defence set up by Mr. Lockwood, and that was that he was only managing director of the Theatrical Production Syndicate, Limited, of which the plaintiffs never heard until after the work was done, all their arrangements being made with Mr. Lockwood and Mr. Nash. While the work was being done the plaintiffs asked for a payment on account, and received a cheque from Mr. Lockwood for £40. The full account of £212 was afterwards rendered, and the balance due, after deducting £40, was now sued for. The plaintiffs said they knew nothing of the Theatrical Syndicate in the matter, and only received their instructions from Messrs. Lockwood and Nash. It appeared that the pantomime was not a success, and his clients had not been able to get the balance due—hence the present action.

Mr. Ernest L. Berry, Associate of the Institution of Electrical Engineers, gave evidence in support of the claim and in support of counsel's opening statement. Evidence was also called for the defence on the lines indicated. It was argued that the pantomime was produced jointly by Mr. Brickwell, the lessee and the Theatrical Productions Syndicate, Limited, of which Mr. Lockwood was managing director, and that Mr. Brickwell as well as the Syndicate was liable for part of the claim. As to the £40 which had been paid on account, counsel for the defendant submitted that it was paid by him on behalf of the Theatrical Productions Syndicate.

In the result the jury found for plaintiffs for the full amount claimed, and judgment was entered accordingly with costs.

CORRESPONDENCE.

Towns' Refuse Problem.

In reply to the letter in your issue of June 29th by "The Writer of the Article," we beg to say that the fact that we have not taken exception to any statements which may have been made does not imply that we agree with them. While there is a tendency in some quarters to exaggerate the calorific power of town refuse, there is in other quarters an equally strong tendency to deny to it the value which it really possesses. At the present time so much sound experience has been collected in regard to the use of refuse burnt in destructors for steam-raising purposes, that reliable figures can be readily obtained by persons seriously interested in the subject.

The Horsfall Destructor Company, Limited.
F. C. Watson, *General Manager.*

I am much surprised to find that the writer of the article still stubbornly adheres to his original statement, and this in the face of the letter from a responsible public official, Mr. Stanley Clegg, the borough electrical engineer of Darwen.

Your contributor still desperately clings to his original erroneous idea, and would justify his tenacity by the splitting of hairs. Surely, if the power available from a destructor is only used for a portion of each 24 hours, instead of the whole time, it is no argument against the employment of refuse as fuel? The fact that steam is blowing off for so long a time merely shows that useful work might be done with the destructor during such time as the electric light is not wanted, and also, concurrently with the lighting to some extent, as it has been conclusively proved that the Darwen plant can deal with nearly 50 per cent. more refuse than is at present available.

In every manufacturing centre of the kingdom may be found works where a proportion of steam is blown away, which is, to some extent, rendered necessary by existing circumstances, and it would be quite as logical for the writer of the article to submit that such people should not use coal, and that they cannot employ it economically, simply because the nature of their work demands the steam pressure being kept at, or very near, blowing off point.

I understand that in the course of another two months the power for the electric traction load at Darwen will be taken from the destructor also, but even then there will be some few hours when the power cannot be used, and therefore, according to your contributor, even when the town of Darwen gets the power for both electric light and traction

from its refuse, still the destructor will necessarily fail to justify its existence.

That I had under-estimated the calorific value of Darwen refuse only serves to show that I was moderate in my claim, but I do not claim that pessimistic moderation enjoyed by the writer of the article. Experience has shown me that there is such a thing as "average refuse," and also that refuse is of great value for useful steam raising.

Any amount of juggling with figures and splitting of hairs will not disprove the fact that good, useful, and economical work is being done at Darwen and also at the other places I mentioned.

There are one or two queries addressed to Mr. Clegg, which, no doubt, that gentleman will reply to. I will only say that I quite agree with Mr. Clegg's statement that it is possible to secure the best results in steam raising concurrently with thorough cremation of the refuse. In fact, if the plant is properly designed, and the boiler is not used like a kettle, not only is good evaporation compatible with thorough cremation, but, what is more, it is inevitable.

Your contributor, in closing his letter, says it is worthy of note that no first-class destructor maker has taken exception to his views. Does it not occur to him that some at least prefer to treat his statements with contempt, while, on the other hand, there are others unfortunately whose destructor can fairly be placed in the category covered by the words complained of?

I am inclined to think that at his end of the scale the pessimist is fully as mischievous in the prevention of the economic disposal of refuse as is the man who, going to the other extreme, makes ridiculously extravagant claims.

What I have said has been amply proved by the letter from Mr. Stanley Clegg, who surely knows something about the matter when he is responsible for the lighting of his town every day from the destructor alone. Yet your contributor says his statement has not been controverted. Very well, let it be so; if Mr. Clegg's letter has failed to make any impression, I may well be forgiven if I give it up as a hopeless task.

Incineratus.

Westminster, S.W., *July 2nd*, 1900.

[A letter from Mr. Stanley Clegg appears in our "Notes" columns this week, being received too late for insertion in this column.—Eds. Elec. Rev.]

An Electric Bell Problem.

I desire to put up two electric bells at a distance from end to end of 1,500 yards, and to use railway metals as a return. What sort of bells would be required? also size of wire, batteries, switches, resistances of bells? How many batteries at each end, and what sort of relays if any required?

Subscriber.

Rawtenstall, *July 2nd*.

[Perhaps one of our readers will oblige our correspondent. —Eds. Elec. Rev.]

Maintenance of Electric Motors.

In your issue of yesterday, in an article headed "The Maintenance of Electric Motors," you request engineers who have some experience on the matter to make their knowledge public. I think I may claim to have some acquaintance with the matter, as I was for over two years city and branch manager to the Electric Light Insurance and Maintenance Company, and have maintained more motors than I should care to count. I hold no brief for any kind of motor, but my experience has been that cheap motors, properly treated, run as well and are as easily maintained as more expensive ones. But they must be properly treated *from the very start*, otherwise the superiority of the good make is soon apparent. I know a very cheap motor, driving a varying load from nothing to full load, changing suddenly. It is looked after by a skilled man, has run four years, and never cost a penny except for new brushes, and never had a file on the commutator. Another I know, by a good maker, has run about five years under about as bad treatment as it could possibly get. A cheap motor would not stand the patching that has had.

If a motor be *anything like passable* when new, that is to say, if the spindle be straight and the commutator round, and if a possible sparkless position exist for the brushes, that motor will run as well as the best you get for money if it is properly treated, by which I mean kept clean and lubricated, brushes trimmed and carefully adjusted, never started or stopped, or the load altered except by a skilled man, and never overloaded. On the other hand, a really good motor will stand ill-treatment (which is the usual treatment) dirt, neglected brushes and commutator, sudden switching on, &c., and still run.

To sum up then, if you have a really skilful and painstaking engineer, use cheap motors, they will serve you as well as more expensive ones; but if not, use the best you can get, and even they will be costly. It is the man, not the motor that makes repairs necessary.

I hope there may be something in this letter that is new and may be useful to your readers.

G. Carew Knight, A.I.E.E.

July 3rd, 1900.

Electrical Cabs.

I read with interest Mr. Oppermann's letter in your current issue.

Certainly the first attempt in this country, and I believe in the world, to operate a public service of electrically propelled vehicles has ended very ingloriously, and I trust London will not long remain with such a record.

Since the Electric Cab Company was started, although only a short time ago, a large amount of work has been done in connection with electric vehicles, and much experience gained. Another attempt would have things nearly as much in its favour as they were against the late pioneer company.

The fact that the cab company has only one charging station must have accounted for much useless running and waste of current and time. An electric cab service for London should have at least three charging stations, taking current from supply companies if possible; a cab could then go to the nearest depôt. Arrangement might even be made for the cabs to get a short charge whilst waiting on the cab stands, just as the Pescetto trams in Italy charge at the end of each run for a few minutes; it would save running to and from the depôt, for which no money is taker.

I think the exposed gearing on the cabs accounted for considerable waste of power. Special attention ought to be paid to gearing, for every fraction of an ampere saved in running is important.

The "Napier" car (petrol) is a striking instance of this point. The better running of this car in the 1,000 miles tour than many equally and even greater-powered cars is attributed solely to its more efficient gearing and general details. When the cab company started they had no actual results to guide them in the choice of accumulators; since, information has been obtained for various types of cells. Parallel grouping of cells ought to be avoided entirely, and the batteries should be put on discharge at the depôt and the cells tested individually at least once a week, for one bad cell may mean 4·5 volts less than the proper running pressure, and it is surprising what a difference 4·5 volts makes to the speed.

As an illustration of the advances made since the Cab Company commenced, the record distance run on one charge now stands at 163 miles, at an average speed of over 10 miles an hour, and the vehicle which accomplished this only weighed some 5 to 7 cwts. more than the London cabs, and ran at least four times the distance.

I trust it will not be long before another attempt is made with electric cabs in London, and if made on proper lines it is, I believe, sure to be successful.

W. S. Naylor.

Newport, Mon., *June 30th*, 1900.

Central London Railway.

Your interesting account of the Central London Railway is rendered still more valuable by the numerous curves which accompany it, but there is one point that is not quite clear.

Referring to the generator magnetisation curve, lettered "Full load" in the right hand bottom corner of p. 970, the conditions under which this curve was obtained are not evident.

It appears probable that the armature current was kept constant throughout this curve, and if this is the correct meaning, the value of this current and of the power factor of the load should be stated in order to make the curve complete.

If you will kindly clear up this doubtful point I shall be much obliged.

H. C. L.

[Our correspondent is quite right; the armature current was kept constant at 98 amperes.—Eds. Elec. Rev.]

JOINT TRANSMISSION OF DIRECT AND ALTERNATING CURRENTS.

The remarkable paper by Mr. Bedell, which will be found elsewhere in this issue, reveals a novel and striking discovery, which no doubt will have many useful applications. We do not wish to be unduly optimistic, nor would it be wise at this stage of its development to heap rash encomiums upon the invention; but it would seem that we have in this the basis of an all-round system of supply to meet the wants of all classes of consumers, capable, with suitable arrangements, of being transformed up or down, of driving direct current motors, of magnetising the fields and energising the armatures of synchronous motors (as suggested by the author), and even of charging accumulators.

We cannot as yet follow the author in his statement that no engineering difficulties arise, although the ingenuity of his theory justifies us in hoping that he may be able to prove our doubts to be groundless.

It is evident that the resultant current will be asymmetrical about the axis, and may even, under certain conditions, be unidirectional; the maximum induction density in the cores of transformers, &c., will, therefore, be increased during one half period and diminished during the other. What effect will this have upon the hysteresis and eddy losses?

Again, in driving direct current motors, although the self-induction of the armatures and fields will choke down the alternating current, will there not be serious eddy current and hysteresis losses in the iron poles and cores due to the undulations which must occur in the current value?

Will it be possible, by merely inserting a choking coil in the circuit, to charge accumulators from the mains?

We might multiply such queries indefinitely were it profitable to do so; but in the meantime we prefer to await the further development of Mr. Bedell's new system.

One thing we would point out—that the resultant pressure is raised by 40 per cent.; if this were done on either a direct or alternating system of the ordinary type, precisely the same saving would be effected as in Mr. Bedell's system. In fact, this saving appears to be essentially due to the increased pressure, and cannot, in our opinion, be claimed as an inherent property of the system.

We shall await Mr. Bedell's further disclosures with the greatest interest.

BUSINESS NOTES.

Annual Outings.—The Westminster Engineering Company went for their annual outing to Taplow last Saturday week. The party sat down to dinner at the Dumb Bell Hotel. In the absence of the principals (Mr. Girdlestone and Mr. Way), through pressure of business, the chair was occupied by Mr. A. E. Penn. The day's proceedings terminated with a concert and dancing.

The employés of the London Electrical Fittings Company, Limited, held their annual outing on Saturday last, and a very pleasant day was spent at Brighton.

The employés of Mr. Wm. Rickard, of Derby, went for an excursion to Matlock Bath on Saturday last.

Institution of Junior Engineers.—Last Friday a deputation of members visited the works of Messrs. Caird & Rayner at Limehouse, where they manufacture evaporators, condensers, feed heaters and pumps. The works, though considerably enlarged, are turning out to their utmost capacity, day and night. Electric lighting and driving are employed throughout. A gas engine-driven dynamo furnishes energy to a number of electric motors made by Mr. J. S. Sneath. On Saturday, 14th, a visit will be paid to Lord Rothschild's estate at Tring, when the electrical machinery and various attractions will be inspected.

Electrical Wares Exported.

Week ending July 4th, 1899.		Week ending July 3rd, 1900.	
Amsterdam	Value £240	Adelaide	Value £80
Bangkok. Teleg. mat.	58	Alexandria	62
Bombay	18	Amsterdam	185
Boulogne	29	Bombay	411
Buenos Ayres	2,161	Brussels	88
,, ,, Teleg. mat.	250	Calcutta	76
Calcutta	238	Cape Town	486
Cape Town	172	Christiania. Teleg. mat.	46
Christiania	37	Colombo	371
Colombo	70	Copenhagen. Teleg. cable	571
Copenhagen	9	Durban	450
Delagoa Bay	8	East London	23
Demerara. Teleg. mat.	141	Gibraltar	183
Durban	342	Hong Kong	377
,, Teleg. mat.	59	Launceston	360
Fremantle	93	Madras	685
Gothenburg	270	Malaga	35
Grenade	25	Melbourn e. Teleg. cable	342
Hamburg	260	New York. Teleg. cable	12,700
Hong Kong	336	Ostend	5
Monte Video. Teleg. mat.	55	Rotterdam	50
Montreal	26	St. Petersburg	350
Ostend	39	,, Teleg. wire	1,205
Port Elizabeth	55	Shanghai	68
Port Said	338	Singapore	36
Rio Janeiro	158	Stockholm	33
Santos	84	,, Teleg. cable	279
Shanghai. 21 tons old teleg. wire (value not declared)	—	Sydney	446
Sydney	506	Tientsin	50
Yokohama	118	Townsville	105
Total	£6,198	Total	£20,088

Foreign Goods Transhipped.

Alexandria. Elec. goods	Value £85
Calcutta. Elec. mat.	79
Total	£164

Bankruptcy Proceedings.—Under the failure of John Evelyn Liardet, 16, Hyde Park Gate, W., and the Old Mill Works, Cowley, Mr. Registrar Brougham, sitting at the London Bankruptcy Court on June 29th, gave judgment upon the debtor's application for the Court's approval of a scheme of arrangement. It will be remembered that the debtor has for some years been interested in water motors, electrical accumulators, hydraulic apparatus for irrigation and a rudder movement recorder. He valued his interest therein at £19,000, subject to realisation, and proofs to the amount of £11,308 had been admitted against the estate. His Honour said he was asked to confirm a scheme to pay to all the unsecured creditors a composition of 20s. in the £ by means of cumulative preference shares in the Motors and Mechanical Appliances, Limited, or at the option of each creditor a cash composition of 7s. 6d. in the £ within one month of approval. Just over a year ago there was another scheme before the Court providing for a cash composition of 7s. 6d. in the £ to be paid to all the creditors. That fell through owing to the debtor's not finding the money, and the Court was then told that a company was to be formed to buy the debtor's inventions for a sum sufficient to pay the composition. That was not done, and now the Court was asked to approve an arrangement whereunder the creditors would receive shares in a company to be formed to acquire and work the debtor's inventions. This was a case in which the Court could not approve the scheme unless it was shown to provide reasonable security for the payment of 7s. 6d. in the £ to the creditors. He was told that the whole of the creditors, with one exception, had declared in favour of receiving payment by means of shares, but he could not hold that shares in a company not yet formed did provide the security required by the Act. He regretted to have to give a decision contrary to the evident desire of the creditors, but he had no option in the matter, and must refuse to confirm the scheme. Application refused accordingly.

Application for discharge will be made on July 18th at Bankruptcy Buildings by F. G. W. J. Adams (Downie & Adams, electrical engineers).

Liquidations.—The Premier Electric Lamp Syndicate is winding up voluntarily with a view to reconstruction as the Premier Electric Lamp Company, Limited. Mr. D. L. Chalmers is liquidator.

Catalogues and Lists.—The Edison and Swan United Electric Light Company have issued a leaflet (No. 137) describing their "Paragon" fan motors. Prices and cuts are given.

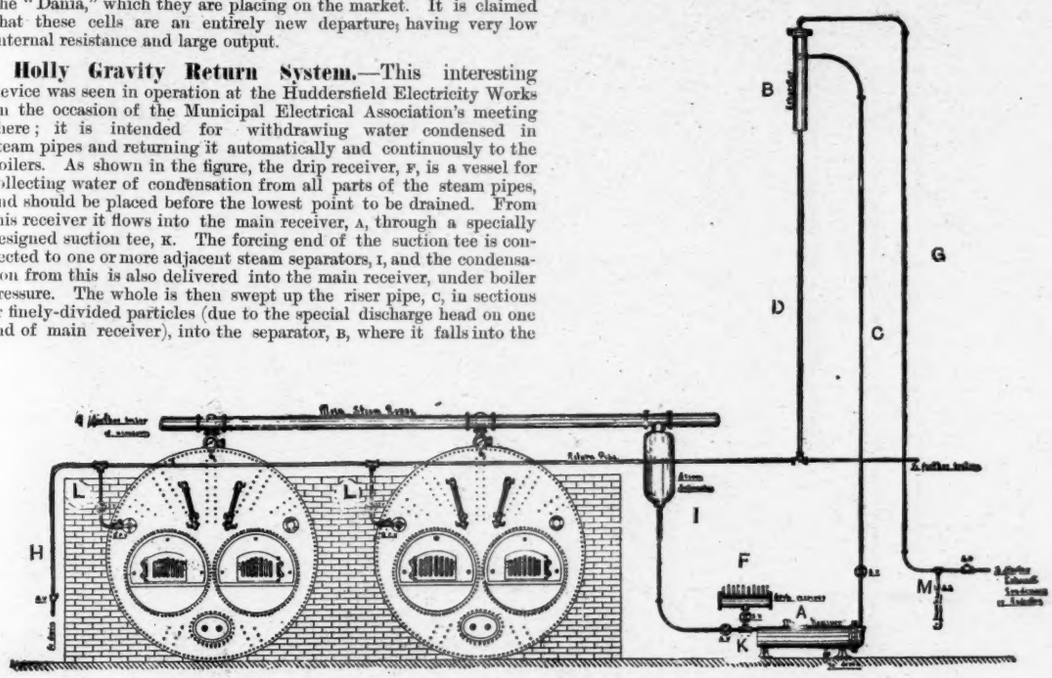
Messrs. J. Smart & Co., of North End, Erith, send us lists of their improved simplicity milling and wheel cutting attachment for lathes.

The Copper Market.—According to the last issue of Messrs. H. R. Merton & Co's. circular, stocks of copper have increased by 59 tons during June, and prices have fallen 30s. per ton. The total supplies reached 26,870 tons, to which total North America contributed 17,886 tons, or over two-thirds. The shipments from Australia and from "other countries" were slightly below the average, while those from Spain and Portugal and from Chili were much below the average for the 12 months. The increased shipments from North America, however, compensated for the deficiency in the supplies from other countries, and the total of 26,870 tons is only 285 tons below the *record* figures of April, 1900. The total deliveries were 25,836 tons, and in addition 975 tons "standard" were shipped to New York. In consequence stocks have only risen from 29,204 tons to 29,263 tons during the month, and are now slightly above the total at which they stood on June 30th, 1899. The price of G.M.B's., which on May 31st was £73 5s., had fallen to £72 7s. 6d. by June 15th, and on June 30th had further declined to £71 15s. Three new copper mining companies have been floated since our last monthly report. The first of these is the Le Roi No. 2, Limited, formed to purchase and work mining

properties covering 72 acres in Rossland, British Columbia. The ore contains copper, silver and gold to the value of $16 per ton, while mining and smelting costs are estimated at $8 per ton. A 25 per cent. return on the capital of £600,000 is expected. The purchase price is fixed at £550,000. The second company is the Velvet (Rossland) Mine, Limited, capital, £200,000, and has been formed to purchase and work mining properties covering 45 acres in the same district of British Columbia. The ore contains copper and gold to the value of $40 per ton; while mining and melting costs are estimated at $10 per ton. An output of 30,000 tons ore per annum is expected. The purchase price is £160,000. The third company, the prospectus of which has just appeared, is the Rossland and Great Western Mines, capital £500,000. The properties are situated in the Le Roi mining district of British Columbia, and cover 78 acres. Ore assaying from 3 to 12 per cent. copper has been found in quantity, with gold and silver contents varying between $4 and $65 per ton. The cost of smelting is not expected to exceed $8 per ton. The purchase price has been fixed at £450,000.

Dry Cells.—We have received from the Atlas Carbon and Battery Company a pamphlet describing a new type of dry cell, the "Dania," which they are placing on the market. It is claimed that these cells are an entirely new departure, having very low internal resistance and large output.

Holly Gravity Return System.—This interesting device was seen in operation at the Huddersfield Electricity Works on the occasion of the Municipal Electrical Association's meeting there; it is intended for withdrawing water condensed in steam pipes and returning it automatically and continuously to the boilers. As shown in the figure, the drip receiver, F, is a vessel for collecting water of condensation from all parts of the steam pipes, and should be placed before the lowest point to be drained. From this receiver it flows into the main receiver, A, through a specially designed suction tee, K. The forcing end of the suction tee is connected to one or more adjacent steam separators, I, and the condensation from this is also delivered into the main receiver, under boiler pressure. The whole is then swept up the riser pipe, C, in sections or finely-divided particles (due to the special discharge head on one end of main receiver), into the separator, B, where it falls into the return pipe, D, which is capable of feeding any number of boilers. The water, in its upward flight, is carried with the steam that is required to maintain the circulation, and occupies some vertical position above the water line of the boilers, in the return pipe, D, where the included column, plus the pressure in the separator, will overcome the boiler pressure, thus producing a continuous feed to the boilers at practically boiler temperature. The object of the small pipe, G, and reducing valve, R V, is to place the engineer-in-charge in absolute control of the circulation between the receiver and separator. It permits an atmospheric escape of steam just sufficient to ensure this result, and it may be adjusted for varying quantities; this escape is so very small as to be infinitesimal, and in nearly all cases it is utilised in the heater, condenser, or otherwise. Should there be no convenient method of utilising the steam passing through valve R V, the pipe is connected to the feed pump discharge, M, and a small quantity of water forced through this small pipe into the upper end of the separator, condensing just sufficient to accomplish the same result. In this way there is no loss of steam whatever, and the circulation is under perfect control by either method. It will be seen that the action is quite automatic, and there are no moving parts whatever; while the system works equally well whether condensation occurs above or below the level of the boilers. The apparatus, which is widely used in America, has been installed at the Huddersfield Works, and is very favourably reported on by Mr. Mountain. Messrs. W. Whiteley & Sons, Limited, Huddersfield, are the sole makers for this country.



Holly Gravity Return System.

Meeting of Creditors.—Henry Vincent James (trading as James and Mills), electrical engineer, Pendleton, Manchester. A meeting of the creditors was held at Manchester on 21st ult. The statement of affairs prepared by Mr. Isaac Senior, chartered accountant, Leeds, showed unsecured trade liabilities amounting to £1,019 4s. 6d., and unsecured cash creditors for £1,431 10s. 5d., a total of £2,450 14s. 11d. The assets consist of stock-in-trade (at cost) and fixtures, fittings, &c., estimated to realise £872 5s. 3d.; book debts—good, £390 2s. 7d., doubtful, £130 8s. 9d., which together are expected to produce £440 2s. 7d.; patents, at cost, £40, making a total of £1,352 7s. 10d. There is a difference of £1,098 7s. 1d. After an explanation of the causes of failure, the meeting passed the following resolutions:—"That the debtor be requested to execute a deed of assignment of his estate and effects to Mr. Isaac Senior, 30, East Parade, Leeds, as trustee for the benefit of the creditors generally, such assignment to contain the usual release by creditors to the debtor." "That the following gentlemen be appointed a committee of inspection: Mr. W. M. Still (W. M. Still & Co., London), Mr. Wm. Russell (Fletcher, Russell & Co., Limited), and Mr. C. H. James, Leeds, two of whom shall form a quorum." In a circular letter to the creditors, Messrs. E. & W. H. Foster, the solicitors, say that in the interests of all concerned it is desirable that a forced realisation of the assets should be avoided, and having regard to the possible value of the debtor's patents, it is hoped that arrangements may be made for disposing of the business as a going concern. No definite value can at present be attached to the patents, the figure of £40 in the statement of affairs merely representing the outlay in fees, &c. In compliance with the foregoing resolutions a deed of assignment is being prepared and will be duly executed.

Prices Advance. — The Electrical Power Storage Company announces an increase in all catalogue prices of 5 per cent. This is due to the continued advance in the prices of raw materials, especially lead, during the last few months.

Private Bills.—In the House of Lords on 2nd inst. the following Bill was read a third time:—City of London Electric Lighting. In the Commons the Great Grimsby Street Tramways Bill and the Liverpool Overhead Railway Bill were read a second time.

Rankine Feed Water Filters.—We have before us a catalogue of the Rankine Patent Feed Water Filter Company, Limited, of Liverpool, illustrating and describing several designs of feed water filters for warships, mercantile marine, and general land purposes, for treating with oil, mud, and other impurities, but what directly interests our readers is one designed specially for electrical plants. This is a system of double filtration through specially woven linen terry cloth. The structural design of this filter is compact and it occupies very little floor or wall space, and can be readily adapted to any feed pipe arrangement, the body being cylindrical and the inlet, outlet, and bye-pass valves lying lateral and in line with the piping. The filtering arrangement consists of an outer filtering cartridge and a series of telescoped inner cartridges, covered with filtering material, which can be increased or reduced in stratum to meet the density of the impurities. The heavier impurities are taken up by the outer cartridge, and the lighter and thinner impurities are arrested by the inner telescoped cartridges. This firm claims for the filter, not only great filtering area, but even surface and an equal distribution of pressure over the filtering arrangement, and no increase of resistance on the feed pumps, owing to the fact that the second filtering surface is as large or larger than the first. Users of steam generators, subject to high, and still increasing pressure, must not overlook the necessity of purifying the feed water before allowing it to pass into the boilers, or disaster may ensue. Engineers understand what the results may be by allowing oil or other impurities to reach the heating surfaces, or vital parts of the boiler, and every increase in pressure increases the danger. Purity of water is essential to the life of a boiler, hence the necessity for feed water filters.

Wheeler Condensers.—The Wheeler Condenser and Engineering Company have secured the contract for the complete condensing plant required for the Portuguese Tramway Company, at their Lisbon power station. This plant has to be supplied in duplicate. They have also the cooling tower and condensing plant required for the Bromley electric light station. Among many orders received by this company recently have been the duplicate orders for condensing sets for the Belfast and St. Helens Corporation electric light station and the Reading Electric Supply Company, also the condensing plant required for the Bedford, Blackpool, Devonport, and West Bromwich Corporation electric supply stations.

ELECTRIC LIGHT AND POWER NOTES.

Abertillery.—A comprehensive scheme for the utilisation of refuse for the production of electricity has been submitted for the consideration of the Council.

Ambleside.—The District Council has resolved that its electric lighting order be leased to the Windermere Electricity Company for a term of 15 years, terminable any subsequent five years, the company to bear the whole cost of obtaining the provisional order, and the light to be supplied on the same terms as to their other customers.

Beaumaris.—The Town Council has received notice from the North British Electrical Supply Company of their intention to apply to the Board of Trade for a provisional order for the supply of electricity within the area of the Council.

Birmingham.—A slight interruption of the supply of electricity to part of the city occurred on Sunday evening last, due to a short circuit on the mains. The trouble was quickly rectified.

Birstall.—The North British Electric Supply Company has intimated its intention of applying to the Board of Trade for powers to supply electrical energy within the district.

Blackpool.—The Corporation has been fined 10s. and costs "or 14 days" for black smoke nuisance at the electricity works.

Brecon.—The Corporation has been granted by the Board of Trade a provisional order for the electric lighting of the borough.

Bridgend.—The Board of Trade has approved of the transfer of the Council's provisional order for electric lighting to the English Industrials, Limited.

Buxton.—Mr. Leeming, of Blackburn, has been appointed assistant electrical engineer to the District Council, at a salary of £120 per annum.

Clewer.—The Windsor Rural District Council have given their consent to the Windsor Electrical Installation Company, Limited, extending their area of lighting into the parish of Clewer.

Croydon.—The Town Council has decided to obtain the sanction of the Local Government Board to a loan of £3,360 for extensions of the arc lighting. The accounts of the electricity works show a profit of £900 for the past year, during which extensions costing £25,000 were carried out. The average price obtained from 401 consumers on the maximum demand system was 4·36d. per unit, while the average for all consumers (595) was 4·67d. In the preceding year the return was 5·62d.

Devonport.—An inquiry was held last week by Col. C. H. Luard, R.E., into the subject of an application by the Devonport Corporation for sanction to borrow £69,727 for electric lighting purposes. A provisional contract had been entered into for the purchase of the freehold of the site for the generating station. Mr. C. Furness, electrical engineer, explained the plans, pointing out that the premises at the waterside frontage would be made capable of storing about 1,200 tons of coal. It was proposed to have three engines. One of 300 H.P. would be used for the lighting, and one of 600 H.P. for traction work. Another engine of 600 H.P. would be held in reserve. They would start the working of the plant with an assured demand for 700,000 units per annum. The system would be low pressure continuous current.

Driffield.—The Northern Counties Electric Supply Company having given the Council notice that it is the company's intention to apply to the Board of Trade for a provisional order for the lighting of Driffield by electricity, the Council has passed a resolution to the effect that it will not consent to the grant of the order.

Dunmanway.—The District Council has decided to apply for a provisional order for electric lighting.

Gloucester.—Tenders have lately been invited for the supply of 500 tons of rough forest slack, delivered in carts at the Corporation electricity works during July, August, and September, as required.

Grantown.—The Police Commissioners have received reports on the introduction of electric lighting from Messrs. Lyon and Crosby, Glasgow, and Mr. D. Halpin, London, and an offer from Messrs. Crompton & Co., Limited. Further inquiries are being made into the matter.

Gwyrfai (Carnarvonshire).—At a meeting of the District Council on June 30th, a letter was read from Mr. Peterson, a London solicitor, notifying his intention of applying for a provisional order to set up electricity works in the district, and to construct an electric tramway to the watering place of Dinas Dinlle. Mr. Peterson was asked to go into the matter more fully before a committee.

Hornsey.—The District Council on Monday resolved that the offers of companies be declined, that subject to modification of details, the scheme of Mr. Hammond, involving an expenditure of £73,350, be adopted for the whole district, and that application be made to the Local Government Board for permission to borrow the money. The cost of mains is put at £31,003; generating station, £28,110; public lighting, £4,700; meters, house connections, &c., £4,575; and general charges, £5,112. Land is not included. The total capacity provided for is 31,600 8-C.P. lamps and 600 KW. Mr. Hammond suggests a charge of 7d. per unit for 100 hours per quarter, with 2d. for the remainder, which he estimates would average 5d. per unit.

King's Lynn.—The price of gas having been raised, the Guardians have decided that the committee, which some months ago took into consideration the question of lighting the Workhouse by electricity, should be re-appointed, and asked to again give the subject their attention.

Lancaster.—Although the consumption of electricity has increased during the year by 22½ per cent., the Electricity Committee of the Corporation shows a net profit of only £421 as compared with £1,191 last year. £250 has been carried to the reserve fund while £459 goes towards the redemption of the new loan of £10,000. The price of energy was reduced during the year from 5d. to 4½d. for lighting purposes, and from 4d. to 3d. for motive power, this accounting for the smaller profit. The capital expended is now £32,795, and powers have been obtained to spend £35,000, leaving £2,205 to expend. The year's total expenditure was £2,318, against £1,683, or 1·97d. per unit against 1·92d. per unit; and the gross income was £4,504, against £4,007. The Gas Committee of the Corporation has decided to increase the price of gas per 1,000 feet from 2s. 6d. to 2s. 9d. The electrical engineer at Lancaster (Mr. W. A. Fraser) is at present serving as a sergeant in the Middlesex Yeomanry in South Africa, the Corporation having allowed him leave of absence during the war, at a reduced salary.

Leamington.—The Town Council proposes to offer to purchase the undertaking of the Midland Electric Light Company for the sum of £17,000.

London.—Battersea.—As a result of an interview with the solicitor to the Post Office, the Vestry has decided to sanction the laying of telegraph tubes in various parts of the parish on the following conditions:—(1) The Postmaster-General shall make good any damage which may be done in the execution or maintenance of the work; (2) the Postmaster-General shall give notice in writing to the Vestry, in case at any time any of the said telegraphs shall be used or required to be used to connect exchanges of the National Telephone Company, or exchanges of the National Telephone Company and post offices; (3) on receipt of such notice as last aforesaid, the Vestry shall be at liberty, by notice in writing, to withdraw the consent hereby given so far as relates to any telegraphs to be used as aforesaid, and the Postmaster-General, if he objects to such withdrawal, shall take immediate steps to obtain a determination of the difference thus arising in manner prescribed by the Telegraph Act, 1878.

London County Council.—The Council, at the meeting last week, decided to approve plans for the extension of one of the boiler houses at the Deptford station, and the erection of a transformer room. It was resolved to postpone until next week a recommendation of the Asylums Committee in favour of an expenditure of £39,000 being sanctioned for the provision of a central station for the supply of water and electricity to the asylums to be built on the Horton estate. The scheme, prepared by Sir Alexander Binnie, the engineer to the Council, provides for the erection of engine and boiler house, &c., well house (with a 40,000-gallon water storage tank), water-softening plant, &c. The proposal is at present limited to centralising the water and electric current supplies for the Horton Asylum and the suggested epileptic colony, but the buildings have been so designed that they can be extended from time to time. The electric lighting plant for the two institutions named is for an installation of 3,800 lamps, equalling 8,187 lamps of 8-C.P. It will also provide the power for 16 motors, varying in size from 22 B.H.P. to 1 B.H.P., for pumping, driving laundry machinery, bread-making machinery, ventilating fans and workshop tools, &c. The system proposed is the three-wire system, with a voltage of 400 between the outer conductors of the mains, the voltage in all rooms occupied by patients and staff being limited to 200; this system will prevent a failure of light should one of the conductors break down. It is intended that the electric lighting plant shall be in readiness for working within seven months from the date of the order.

Malton.—The District Council has concluded an agreement with the Northern Electric Supply Association for the electric lighting of the town.

Melrose.—At a special meeting of Melrose Burgh Commissioners last week, it was resolved to approve of and support Messrs. Crompton & Co.'s application for a provisional order to supply electricity to the burgh.

Manchester.—The accounts of the Electricity Committee of the Corporation for the year ended March 31st last show that the total quantity of electricity accounted for amounted to 6,468,405 units, an increase of 24 per cent. over the previous year. The consumers numbered 3,240, an increase of 670. Additional mains were laid to the extent of 47 miles 530 yards, making the total length laid 110 miles 45 yards. Revenue derived from sales of energy, &c., amounted to £86,298 (which works out at 3·20d. per unit), and the working expenditure to £49,906, showing a gross profit of £36,392. From this sum is deducted an amount of £27,200 on account of interest and sinking fund, and a net profit is shown of £9,193. This surplus, together with the balance of £2,000 brought from last year's account and £572 interest on reserve fund investment, making a total of £11,765, has been appropriated in the following manner, viz.:—Paid to city fund in aid of rates, £10,000; placed to reserve fund, £1,765. At March 31st the total capital expenditure was £641,822; mortgage debt, £556,278; amount of mortgages redeemed to date by action of sinking fund, £49,233; balance at credit of renewals suspense account, £335; ditto reserve fund, £13,361. The accident which happened to the machinery at Dickinson Street station in September last did considerable damage. The amount withdrawn from the reserve fund on account of the breakdown was £7,070. The work in connection with the buildings at Bloom Street station is proceeding with all despatch, and the several contractors have the plant in a forward state. Considerable progress has been made with the laying of electric mains in the districts of Withington, Moss Side, and Levenshulme; the supply has been available in portions of Moss Side since December last and in Withington since February last. On September 30th last the price of electric energy to long-hour consumers was reduced from 1½d. to 1¼d. per unit, and a similar reduction was made in the price of energy supplied for motor purposes.

Alderman Higginbottom (chairman) and six other councillors have been appointed by the Electricity Committee of the City Council to visit and inspect the exhibits of electrical plant and machinery at the Paris Exhibition. *Bon voyage, Messieurs!*

Monmouth.—Owing to the success of electric lighting in the town the generating station is being considerably extended, and tenders for the work have been accepted by the Town Council. At the last meeting a gratifying report was received from Mr. A. N. Blake, the electrical engineer, showing that a satisfactory initial year had been experienced.

Newport.—The Borough Council has applied to the Board of Trade for power to supply electricity at 200 volts.

Padstow.—The District Council is inquiring into the matter of electric lighting for the district.

Rochester.—The Rochester, Chatham and District Electric Lighting Company are taking advantage of an increased charge in the price of gas, and are specially advertising a reduction in their charges. The company have just added to their works at Chatham a 1,000-H.P. Parsons turbo-alternator, and there are in course of erection two Lancashire boilers to meet the increase of demand for electric light.

Southport.—The Southport Corporation has spent more than £100,000 so far on its electricity works, and stands committed to nearly £40,000 more. Most of this is in regard to the alternating current system, but the latest additions to the plant are for the production of continuous current. Colonel A. J. Hepper, R.E., held an inquiry last week into an application to borrow £9,000 for the provision and laying down of suitable cables. The new tramway system, now nearly completed, is to be worked on the continuous current system, and the Corporation expects to supply current to the Southport Tramways Company, the Pier Company's tramway, the Ormskirk light railway, the Southport and Lytham tramways, the Lancashire and Yorkshire Railway Company for a new station at St. Luke's, and for arc lighting and power generally. No opposition was offered to the application.

Sunderland.—The report of the electrical engineer, Mr. J. F. C. Snell, for the past year shows a total lamp connection of 35,024, an increase of 36 per cent. during the year. The energy sold was 640,079, an increase of 35 per cent. The capital outlay stands at £89,912, or £74 per kilowatt installed; the extensions now in progress will increase the expenditure to £111,100, equivalent to £56 per kilowatt installed. The gross profit for the year was £4,047, the net profit £467. There is a considerable demand for power for the docks and workshops, as well as for domestic and trade appliances.

Wirral.—The District Council has received notice from the Heswall Gas and Electrical Company of their intention to apply to the Board of Trade for a provisional order for the electric lighting of Heswall, Barnston, Pensby and Gayton.

ELECTRIC TRACTION NOTES.

Birkenhead.—Residents in some of the Birkenhead districts are protesting against the proposal of the Tramways Committee to pave the electric tramways in Shrewsbury Road with granite setts. Granite would be too noisy for them, and they want wood paving instead.

Black Country.—Notwithstanding the hostility of the Wolverhampton Corporation to the British Electric Traction Company, that company has been successful in coming to an amicable agreement with all the other ruling authorities in the Black Country, with the result that this densely populated district will very shortly have a complete network of tramways under one system, extending throughout the entire Black Country from Wolverhampton (that is, from outside the borough limits) to Birmingham. Bilston, Willenhall, Darlaston, Wednesbury, and West Bromwich have each made terms with this company. These terms have already received the private sanction of the respective Councils, and in a limited period the overhead electric traction, with up-to-date cars and a quick service, will replace the old worn out steam engines and cumbersome cars at present in vogue. On the main road from Dudley to Oldbury the British Electric Traction Company, it is now stated, have secured leases from the local authorities to continue this overhead service, and they are only awaiting the consent of Smethwick and Birmingham to equip the lines right into Birmingham. The present Smethwick lease expires in 1902, but the Birmingham lease has seven more years to run.

Bradford.—The Electricity Committee of the Corporation has resolved to apply to the Local Government Board for sanction to borrow a further sum of £140,000 for the erection of a new generating station, and for additions to existing stations, and for further machinery and plant.

Eccles.—The Town Council has decided to advertise for a consulting electrical engineer to advise generally on the electrical equipment of the tramways.

Manchester.—A beginning has just been made, says a Manchester paper, at Cheetham Hill in the work of laying the new metals in connection with the Manchester Corporation electric tramway system. The first section to be finished is the Cheetham Hill one, starting from a point opposite the new Presbyterian Church to Albert Square. The existing line is being taken up in lengths of about 100 yards, the up and down traffic being diverted by means of portable cross-over tracks on a single rail. At present only 100 men are engaged on the new section. It is hoped to complete the Cheetham Hill section about October, or, at any rate, before the end of the year. The route along Rochdale Road will then be started, followed by that along Bury New Road. If possible, the Committee expect to have the whole of the existing lines reconstructed at the end of two years.

Middlesex.—With reference to the London United Tramways Company's Extension Bill, which has already passed through the House of Commons, a Committee of the Middlesex County Council has reported that it is desirable, with a view to a uniform and comprehensive scheme of locomotion throughout the county, that all the light railways and tramways should practically be under the control and management of the County Council, and the Committee expressed the opinion that it would hardly tend to the convenience of the public and the interests of the county generally that, whilst most of the trunk lines were under the control of the County Council, some of the tramways and light railways should be in the hands of private companies, and some sections in the hands of the district councils. The Committee therefore recommended that the London United Tramways Company should be informed that the Council would be prepared to limit its opposition to clauses if the company and the district councils affected would consent to the Bill being amended so as to provide that the County Council should be the purchasing authority at the end of the period limited by the Bill. The recommendation was passed, but the opinion was by no means unanimous.

Musselburgh.—All opposition has been withdrawn to the promotion of this scheme before Parliament.

New Forest.—At a meeting of the Lyndhurst Parish Council, held a few days ago, a favourable reception was accorded to a letter from Mr. Ernest A. Kite, solicitor, inquiring if the Council would consent to the construction of an electric tramway from Lyndhurst Road railway station to Lyndhurst, and also to the installation of the electric light in the town. It was stated that the full length of the line would be about 2 miles 6 furlongs, and that plans, with the full details, and the necessary provisional order or Parliamentary Bill, would be deposited in due course. It was urged by a member that the project would be beneficial, and should, therefore, be cordially supported. It was decided that the application should stand over until the return of the Hon. G. Lascelles, the local representative of H.M. Commissioners of Woods and Forests.

Pwllheli.—At a special meeting of the Highways Committee of the Carnarvonshire County Council held on Tuesday, it was agreed to favourably recommend to the consideration of the Council the proposal to construct an electric tramway from Pwllheli to Nevin, subject to certain conditions urged by the Pwllheli Town Council and several Parish Councils as to the width of roads and the placing of sleepers. The movement, if carried out, will tend to develop seaside places as yet difficult of access.

Swansea.—This town, which shares with Cardiff the distinction of being in the forefront of Welsh municipalities, was *en fête* on Saturday last on the inauguration of the new electric tramways provided by the British Electric Traction Company, at an outlay of £100,000. Indeed, in this particular phase of enterprise

Swansea even distances every other town in the whole of the Principality, for it is the first town in Wales to have an electric street tram service, as it was many years ago the first to have railway provision. The assembly proved exceptionally representative. It included the principal members of leading Corporations and District Councils in South Wales, as well as other public officials. The Mayor of Swansea (Mr. Watkins) made his appearance at noon, accompanied by Mr. Emile Garcke, the managing director of the British Electric Traction Company; Mr. H. M. Sayers, the chief engineer in the power department of the company; Mr. Martin, chairman of the Electric Committee of the Swansea Corporation; Sir Robert Morris, Bart., M. de Guerrier, and others, and discharged the pleasing duty of switching on the current with a commendable absence of rhetoric, merely remarking that the performing of the duty gave him great satisfaction, as Swansea and district could now boast of being in possession of an electric tram service second to none in the kingdom. The company's representatives and guests (who altogether numbered over 150) afterwards travelled over the system in five of the cars, well decorated with bunting, to the opposite terminus at Morriston, about four miles away. The time taken to cover the ground was 25 minutes. The service links the one extremity of the line on the seaboard with the vast network of industries which have given to Swansea its industrial fame as a centre of tin, copper, chemical and other manufactures. Subsequently the proprietory company entertained their guests at an excellent luncheon at the Hotel Metropole. Mr. Emile Garcke, the chairman of the company, took the chair, and the proceedings throughout were in every sense a great success.

After the toast of "The Queen," the Chairman followed with "The Town and Trade of Swansea," and after passing high encomium upon what he described as the metallurgical metropolis of the world, for it smelted seven-eighths of the metals produced in the United Kingdom, he referred to municipalisation of industrial undertakings, such as tramways, and argued at some length in favour of the principle, remarking that there were a large number of enterprises carried on by private capital which could be carried on better and more cheaply by the collective powers of a Town Council, but without ulterior motive of making a profit. The Corporation had called in the company to construct tramways, imposing upon it conditions that it should do its duty to the public in the best and most capable way. Having done this, it was entitled to its reward, and he put it that if they wanted to develop the town they must offer every encouragement they could to capitalists. He reminded those present how the company had only a certain number of years in which to get back its capital, and he asked them to help it to do its work without unnecessary embarrassment or harrassing. In order to make the venture pay, it was necessary that they should offer such inducements to the public in the way of better accommodation, &c., as to secure four times the patronage accorded to the old system.

The Mayor and Mr. Griffith Thomas responded, and after the toast of the day—"The Swansea Improvement and Tramways Company," had been duly honoured, the proceedings ended with the toast of the Chairman's health, which was drunk with musical honours.

Special saloon facilities were afforded by the company during the afternoon to the guests for a trip to the Mumbles, one of the most popular of Welsh watering places. It transpired that the electric cars did splendid business on the Saturday. All the different sections were crowded by passengers. It is understood that the company are retaining the services of the old employés of the Swansea Tramway Company, and it is further stated that the hours of labour have been reduced, and the wages increased, and that the men are supplied with outfits to suit all weathers.

TELEGRAPH AND TELEPHONE NOTES.

Imperial Telegraphic Communication.—At the congress of the Chamber of Commerce last Friday Sir E. A. Sassoon, M.P., stated that in order to consult the convenience of the congress it had been decided to amalgamate all the resolutions on the business paper, dealing with the question of cable communication with the Empire into a single resolution. The proposal which he had to submit, on behalf of the Liverpool Chamber, would read as follows:—

That this congress recommends that support should be given to the action which the Imperial Telegraph Committee of the House of Commons is taking with the view of placing the important matter of electrical communication between the United Kingdom, India, and the British colonies and dependencies on a footing commensurate with present conditions of inter-Imperial and colonial relations.

That copies of the foregoing resolution be addressed to the Prime Minister, the First Lord of the Treasury, the Chancellor of the Exchequer, the Secretary of State for India, the Secretary of State for the Colonies, and the Postmaster-General, urging that every reasonable opportunity may be given in Parliament for the discussion of the position of the telegraph companies in relation to the Government, with a view to an immediate and satisfactory solution being found for the very serious grievance under which the commercial and industrial communities of the Empire have been labouring for a long time past.

That in view of the great object to be attained this congress is strongly of opinion that it would be wise policy to make full provision for ultimate State ownership in any arrangements hereafter made to lay cables by private companies between British possessions in any part of the globe.

That this congress recommends that the principle of State ownership be especially provided for in the cable proposed to be laid by a private company between South Africa and Australia.

And that this congress urges on the Government the importance of instituting a searching investigation by the department committee proposed by Mr. Hanbury into both the shortcomings and the merits of the private system of cables, and, consequently, into the desirability or otherwise of adopting such a course of policy in future as would lead to the ultimate expropriation of private cables and to the establishment of State-owned cables throughout the empire, and to report thereon at the earliest opportunity, such report to be accessible to the public.

After a long and interesting speech from Sir Edward, Sir Thomas Jackson seconded the resolution, which was supported by Sir Frederick Young, Dr. Parkin, and others, and carried unanimously.

The following resolution by the Vancouver Board of Trade was afterwards passed:—

That the congress desires to call special attention to the necessity of completing the all-British Pacific cable, not only on commercial grounds, but in the interests of Imperial security.

Lord Londonderry and the Telegraphists.—On Thursday, June 28th, the Marquis of Londonderry, accompanied by Sir Geo. Murray, the Secretary of the Post Office, met a representative deputation of members of Parliament in committee-room B. of the House of Lords. The deputation comprised Sir Albert K. Rollit, Mr. W. C. Steadman, Mr. Jacoby, Mr. Bailey (Chesterfield), Mr. Patrick O'Brien, and Col. Dalbiac. The subject of the interview was the wages of telegraphists, and the necessity for a Parliamentary inquiry. Sir Albert Rollit introduced the deputation, and urged the claims of the London telegraphists to consideration, in view of the very moderate counsels which had prevailed with them in their movement, even at the time of great excitement in 1897. The recommendations of the Tweedmouth Committee, and the conditions of service of the men demanded that the barrier, which was placed at £160 in London, should be removed, and he urged Lord Londonderry to remedy the grievance or agree to the appointment of a Select Committee of the House of Commons to go into the question and finally settle it. Mr. W. C. Steadman supported Sir Albert Rollit's remarks on the question of the London maximum, laying particular stress on the breach of contract, which he said was flagrant. It was useless to endeavour to avoid a remedy by sheltering behind the finding of the Tweedmouth Committee. A promise had been made, and all the principles of justice and commercial honour demanded its fulfilment. In reference to the provincial case, he said Mr. Fawcett laid it down as a principle in 1881 that the telegraphists and the sorting clerks should be on an equality as regards pay. A Return issued on the motion of Mr. Jacoby showed that promotion on the postal side was twice as rapid as on the telegraph side, and this condition violated the principle of equality, which should be restored either by an increase in the avenues of promotion or compensation should be given by an increase of pay. Mr. Patrick O'Brien said that in Ireland the same conditions of inequality prevailed, and the discontent engendered was detrimental to the best interests of the service. The demand of the men for an independent inquiry was a reasonable one, and would settle the difficulty more satisfactorily than any other means. Mr. Jacoby also drew attention to the inequality which was manifested by the Return granted on his motion, and urged reasons for an impartial inquiry. Mr. Bailey said it was the duty of the State to keep its employés abreast of the times, and the condition of the Service showed this had not been done. He quoted figures to prove his contention. He thought the easiest and most satisfactory method of settlement was that demanded by the men, viz., an independent Parliamentary inquiry. Colonel Dalbiac dwelt at some length on the question of the London maximum, and urged Lord Londonderry as a man of commercial experience to look into this matter for himself, and he was sure he would see that an injustice had been committed which demanded remedy. The Marquis of Londonderry expressed his great pleasure at receiving the deputation and his desire to deal justly with the men. He would carefully consider all the representations made to him by the hon. members. He did not feel prepared at present to revise those matters which had been dealt with by the Tweedmouth Committee and the Norfolk-Hanbury conference, although any falling short from those recommendations should be remedied. With regard to the great stagnation of promotion, he thought a case had been made out, and he would certainly make it his business to look into it with a view to remedy. The deputation then withdrew.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
CHINESE:—		
Hong Kong-Macao	June 28, 1900	
SOUTH AMERICAN:—		
Cayenne-Pinheiro	Oct. 11, 1899	
Cayenne-Paramaribo	Feb. 16, 1900	
Pará-Maranham	March 1, 1900	
Ceará-Maranham	Feb. 20, 1900	
WEST INDIES:—		
Jamaica-Colon	June 20, 1899	
Mole St. Nicholas-Cape Haitien	March 6, 1900	
Latakia-Cyprus	June 20, 1900	
Tarifa-Tangier	Jan. 2, 1900	
Gibraltar-Tangier	June 28, 1900	
LANDLINES:—		
CHINESE:—		
Tientsin-Pekin	June 12, 1900	
Pekin-Kalgan	June 14, 1900	
Kalgan-Maimatchin	June 30, 1900	
Tientsin, *via* Shanghai	June 16, 1900	
Tientsin-Newchuang	June 18, 1900	
SOUTH AFRICA:—		
Communication beyond Ladysmith (Natal)	Nov. 7, 1899	Restored as far as Standerton.
SOUTH AMERICAN:—		
Barcelona, Venezuela-Cindad-Bolivar	July 2, 1900	
Communications with all offices of Columbia beyond Buenaventura	January 23, 1900	
Ecuador landlines	Mar. 13, 1897	
Landlines south of Macahé (Brazil)	April 25, 1900	
SIBERIAN:—		
Irkutsh-Tschita	June 28, 1900	June 29, 1900
Communication "*via* Hanekine" interrupted on Persian territory	Feb. 24, 1900	

Manchester Telephones.—The City Council has received a memorial from the Mutual Telephone Company in reference to their application for a municipal license. This has been referred to the special committee.

The New Atlantic Cable.—The ss. *Faraday*, belonging to Messrs. Siemens Bros., Limited, sailed from Woolwich on 2nd inst. carrying 1,200 knots of the new Atlantic cable.

Telegraph Cables in the Far East.—A *Times* correspondent telegraphs:—

The Chinese telegraph service is increasingly defective. Ordinary messages from Chefu to Shanghai lately were five days late, and the post two. It is urgently necessary that the Government should conclude an arrangement on the terms proposed by the Joint Cables Company for an immediate extension of the British cable from Shanghai to Ta-ku. The need both now and hereafter is imperative. The subsidy would be only a trifling consideration.

The Telephone Service.—In the House of Commons last Friday, Mr. Hanbury informed Mr. Provand that the construction of the underground system of wires for the Post Office telephone service in London was proceeding as rapidly as possible, and that the rates and conditions of service would be published as soon as the Postmaster-General was able to give a definite date for the opening of the central exchange.

CONTRACTS OPEN AND CLOSED.

OPEN.

Beckenham.—July 16th. The District Council wants tenders for a free wiring contract. See "Official Notices" June 29th.

Belgium.—July 14th. The municipal authorities of Jumet are inviting tenders until July 14th for the concession for the public and private electric lighting of the town. Tenders to be sent to Le Secretariat Communal, L'Hotel Communal, Jumet, Belgium, whence particulars may be obtained.

Blackpool.—July 23rd. The Corporation wants tenders for trolley poles, cables and trolley wire, boosters and switchboards, and storage battery. See "Official Notices" June 22nd.

Brussels.—September 19th. The Council of St. Jilles, lez Bruxelles, invites tenders for the installation and the commencement of supply upon a part of its territory. Conditions and plan for three francs at the office, No. 14, Parvis St. Jillies, St. Jilles.

Durban.—July 20th. The Corporation wants tenders for overhead equipment for (*a*) about 16 miles of single track, including poles, overhead trolley wire, distribution boxes; (*b*) 22 double-deck motor cars; (*c*) steam and electric generating plant, including three 250-KW. generators, boilers, condensers, cooling towers, switchboard, &c. See "Official Notices" May 18 and June 15th.

Edinburgh.—July 9th. The Corporation wants tenders for the supply of copper strip for electrical conductors. See "Official Notices" June 22nd.

Germany.—July 25th. Tenders are being invited until July 15th by the Baden State Railway authorities at Carlsruhe for the supply of two large multiphase alternators required for a central station they are establishing at Mannheim. Tenders are to be sent to Die General Direction der Grossl Badische Staatseisenbadnen Carlsruhe, where particulars may be obtained for 3s.

Grays Thurrock.—August 9th. The Council is inviting tenders for Lancashire boilers, 100-KW. steam dynamos, economisers, switchboards, battery, crane, mains, and other plant, &c. See "Official Notices" June 29th.

Hammersmith.—July 12th. The Vestry wants tenders for insulated high and low tension cables, junction boxes, cast-iron pipes, draw-box covers, &c. See "Official Notices" June 29th.

Huddersfield.—July 12th. Tenders are wanted for a single-phase steam generating plant (1,000 KW.). See "Official Notices" July 29th.

Islington.—July 25th. The Vestry wants tenders for relaying York and other stone over electric conduits and mains. See "Official Notices" to-day.

Italy.—July 14th. The municipal authorities of Maddalena (Sardegna) are inviting projects and tenders until July 14th for the electric lighting of the public streets of the town. Particulars may be obtained from, and schemes and tenders are to be sent to, Il Municipio di Maddalena (Sardegna).

King's Lynn.—July 9th. The Corporation is inviting tenders for extensions to the electricity station buildings.

London.—July 10th. The London County Council is prepared to receive tenders for the supply, within three months of the order being given, of about 70 arc lamp standards, required in connection with the electric light installation for the Victoria Embankment. Specification, form of tender, and other particulars at the engineer's department, County Hall, Spring Gardens, S.W., upon payment of the sum of £1.

Lowestoft.—July 10th. The Corporation wants tenders for direct current meters and cut-outs. See "Official Notices" to-day.

Madrid.—August 18th. Tenders are invited by the Spanish Government, not later than August 18th, for the concession of a system of electric tramway lines in Barcelona. Some particulars may be examined at the commercial department of the Foreign Office between 11 a.m. and 5 p.m.

Manchester.—July 10th. The Corporation wants tenders for alterations required to the existing wiring at the Victoria Hall. Tenders from the City Surveyor, Town Hall, on payment of one guinea.

Newport.—The Newport (Mon.) Borough Council are prepared to receive tenders for Bessemer steel girder rails, Bessemer steel fishplates, wrought-iron tie bars, fish-bolts, nuts, and washers, for the new electric railway on Corporation Road.

Newport (Mon.).—The Corporation is inviting tenders for the construction of 1½ miles double line of tramways along Corporation Road. The trams are to be run by electric traction.

Partick.—July 10th. The Commissioners want tenders for the supply and laying of insulated mains, conduits, junction boxes, &c.; the supply and erection of cast-iron arc and incandescent lamp standards, arc lamps, automatic switches, &c. See "Official Notices" June 29th.

Rochdale.—July 14th. Tenders are invited for wiring the municipal technical school for electric lighting. See "Official Notices" to-day.

Roumania.—July 17th. Tenders are being invited until the 17th inst. by the Roumanian Post and Telegraph authorities in Bucharest for the supply of 40 tons of galvanised steel wire, 2 mm. diameter.

Salford.—July 16th. The Corporation wants tenders for overhead equipment for the electric tramways, exclusive of the supply of poles, but inclusive of their erection. See "Official Notices" June 22nd.

South Shields.—July 14th. The Guardians want tenders for an electric light installation at the Union Workhouse, Harton, South Shields. See "Official Notices" June 22nd.

Southend-on-Sea.—July 25th. The Corporation is inviting tenders for (*a*) boilers and auxiliaries; (*b*) steam generators, and switchboards and crane; (*c*) feeders and distributors; (*d*) line equipment; (*e*) trucks and car equipments. Specifications, &c., from Mr. Alfred Fidler, A.M.I.C.E., borough engineer. Deposit three guineas.

Spain.—July 7th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Ambassador at Madrid, stating that tenders are invited by the Spanish Government, to be received not later than July 7th next, for the concession for an electric tramway from the Puerta de Hierro (Madrid) to Aravaco and Pozuelo. Some particulars may be examined on personal application at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Spain.—July 10th. The municipal authorities of Calzada de Calatrava (province of Ciudad Real) are inviting tenders until July 10th for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Calzada de Calatrava (Ciudad Real).

Spain.—July 21st. The municipal authorities of Algemesi (Province of Valencia) are inviting tenders until July 21st for the concession for the electric lighting of the town during a period of 10 years. Particulars are to be obtained from, and tenders to be sent to, El Secretario del Ayuntanicente de Algemesi (Valencia).

Warrington.—The Corporation wants tenders for the installation of electric light into the Town Hall, bank house, museum, and other public buildings. See "Official Notices" June 22nd.

Wimbledon.—July 18th. The District Council wants tenders for supplying and fixing telephones at the Isolation Hospital. See our "Official Notices" to-day.

CLOSED.

Keighley.—The Town Council proposes to accept the tender of Mr. T. E. Sugden for the erection of municipal electricity works, at a cost of £3,260.

London.—The Bermondsey Vestry have been recommended to accept the tender of Messrs. W. T. Glover & Co. for the supply and laying of cables and ducts for the sum of £8,018. The list of tenders was published in our issue of the 22nd ult.

London.—The directors of Madame Tussaud & Sons, Limited, have received the following tenders for the extension of their electric lighting plant. The specification for this included two

30-kw. steam dynamos, two Babcock & Wilcox steam boilers, each with 526 square feet of heating surface, switchboard, and connecting cables :—

Tenderer.	Dynamo.	Engine.	Price
Messrs. Johnson & Phillips ..	Own make	Alley-Maclellan	£1,775
,, Crompton & Co. ..	,,	Willans ..	1,963
,, ,, ,, ..	,,	Reavell	1,722
,, Bruce Peebles & Co. ..	,,	Willans ..	2,158
,, ,, ,, ..	,,	Browett-Lindley	1,948
,, ,, ,, ..	,,	Reavell ..	1,928
,, ,, ,, ..	,,	Alley-Maclellan	1,918
,, Drake & Gorham	Parker's	Willans ..	2,058
,, Christy Bros. & Middleton	Crompton.	Browett-Lindley	2,126
,, ,, ,,	,,	Willans ..	2,154
,, ,, ,,	,,	Reavell	1,924
,, ,, ,,	,,	Allen & Co. ..	2,116
,, J. H. Holmes & Co.	Own make	Willans ..	2,150

The tender of Messrs. Johnson & Phillips was accepted under guarantee to deliver and erect one steam dynamo in eight weeks.

The tender of Messrs. James Simpson & Co., Pimlico, was accepted at the same board meeting for the supply of the steam and exhaust pipes, feed pumps, feed heater, calorifier, and all the necessary apparatus to enable the exhaust steam to heat the building on the system of the Atmospheric Steam Heating Company. The amount of this tender was £560. Mr. R. W. Weekes, M.I.E.E., A.M.I.C.E., is the consulting engineer for the work.

London.—The St. Pancras Vestry on Wednesday considered tenders for the supply of cable as follows :—

	£	s.	d.
British Insulated Wire Company	2,675	10	2
Western Electric Company (accepted)	2,618	9	8
Siemens Bros. & Co.	2,575	15	4
Callender's Cable Company	2,506	12	2

The report of the committee recommended the acceptance of the tender of Messrs. Callender & Co., but the chairman substituted the name of the Western Electric Company, because the tender of the former was not in accordance with the specification, which required an insulation resistance of 1,500 megohms, whereas Messrs. Callender only proposed 500 megohms.

Woolwich.—The following tenders were sent in for the electric lighting of the new Grand Theatre, Woolwich, for Clarence Sounes, Esq. The work will be carried out to the specifications and under the superintendence of Mr. John Hewett, of Harrup, Hewett & Duffield, consulting engineers.

	Sec. 1. Stage lighting.	Sec. 2. Switch-board.	Sec. 3. Audi-torium.	Sec. 4. Fittings.	Total.
	£ s. d.	£ s. d.	£ s. d.	£ s.	£ s. d.
Edison & Swan	..	..	..	185 0	..
Hodges & Todd	..	468 10 6	..	..	..
Blackburn-Starling	972 15 0	..	937 0 0	..	..
Chard & Co.	942 0 0	..	..	..	..
Berry, Harrison & Co. ..	1,506 12 9	..	1,090 8 0	204 5	..
Strode & Co.	1,080 0 0	525 0 0	880 0 0	204 5	2,689 5 0
Sotheby & Co.	1,272 0 0	487 0 0	644 0 0	204 5	2,607 5 0
H. South & Co., Ltd. ..	1,210		760 0 0	204 5	2,174 5 0
P. C. Middleton & Co., Ltd.	1,093 0 0	297 4 0	486 9 6	225 5	2,096 18 6
Vaughan & Brown, Ltd. ..	864 0 0	236 0 0	505 0 0	185 0	1,790 0 0

The tender of Messrs. Vaughan & Brown, Ltd., has been accepted.

NOTES.

Protection from Fire.—Last week we alluded very briefly to the fire which took place last Sunday week on the premises of Messrs. Siemens Brothers & Co., Limited. The majority of the telegraph and electrical works in the East of London have, during the past few months, been visited by fires of a more or less extensive nature, and the frequent recurrence of such outbreaks forces us to the conclusion that some of them must be the work of incendiaries. At a time when the electrical works are so fully engaged with important contracts a fire is a particularly serious matter, causing as it does a dislocation of business as well as a loss of both time and trade. Some few weeks ago we drew attention to a test we had witnessed of Grinnell's fire extinguishing system. This apparatus is automatic in its action, no human agency being required to work it, and connected to it is an alarm gong, which also acts automatically. In view of our suspicion as to the cause of these fires, this invention should specially appeal to the owners of the class of works mentioned, and in our own minds we feel confident that the system, once generally adopted by them, would promptly do away with these fires of an incendiary nature, inasmuch as the Grinnell apparatus cannot be tampered with without the fact being immediately made known through the alarm. It should be borne in mind that where a Grinnell installation is adopted, a substantial reduction can always be obtained from fire offices insuring the risk; indeed, they are only too pleased to encourage the application of this means of fire protection, which has proved itself so successful, both in this country and America, over a period of 18 years.

The maintenance of an Electric Tramway Track.—We publish elsewhere the report of an interesting case from the Irish Queen's Bench Division, in which it was decided that the Dublin United Tramways Company are bound to "sand" their tracks so as to prevent the same being a source of injury or danger to the public. Seeing that to lay a sufficient quantity of sand for this purpose will cost the company no less than £2,000 a year, it is easy to understand why they appealed to the Queen's Bench Division from the conviction of the magistrate. The main question under discussion in this case formed the subject matter of a legal query in our issue of June, 15th, 1900. In our answer to that query we stated that there was no obligation cast by the Tramways Acts upon a company to lay sand in the streets, but it would seem that the majority of the Court in the case under notice have arrived at a different conclusion, being of opinion apparently that this duty comes under the heading of "repair." Without having an opportunity of referring to the terms of the Dublin United Tramways (Electric Power) Act, 1897, it is difficult to say whether the principle now enunciated as applicable to Dublin is capable of any wider extension. According to the dissenting judgment of Mr. Justice Boyd, the words "shall maintain in good order and repair, &c., so as not to be a danger or annoyance to the ordinary traffic," which occur in Section 37 of the Dublin Act, refer only to "structural works, wires, tubes, and electrical apparatus." We cannot help thinking that in placing the burden of sanding the streets upon the tramway company, the Corporation travel outside the powers conferred upon them by the Act. In any event it is unfortunate that the case cannot be taken to a higher Court. Had the Corporation themselves done the work, and then sued for the price the case might have gone to the House of Lords. As it is, however, the point is decided irrevocably in Dublin, and the unfortunate company must sand the streets for all time.

The New Laboratories at Owens College.—On Friday last the new physical and electrical engineering laboratories at the Owens College, Manchester, were opened by Lord Rayleigh. Owens College now possesses the most spacious physical laboratories in the United Kingdom, ample room being provided for developments for some years to come. Most of England's, and some of America's distinguished scientists were present at the opening ceremony, being afterwards entertained by Prof. Schuster in the afternoon, and by the Council of the College at a conversazione in the evening. The arrangements for the instruction of electrotechnics are extensive, and are contained in the Dr. John Hopkinson memorial laboratory, which owes its being largely to the family of the late Dr. John Hopkinson, who was once a student of the College. Special attention is drawn to the electro-chemical laboratory, where arrangements have been made whereby 1,000 amperes are available. The floor of the dynamo house is partially open, and it is intended to place the dynamos on rails bridging over this opening. The gas engine underneath will drive a long shaft, and the straps driving the machinery will pass through the opening. When the dynamos are in position, the openings will just allow the various straps to pass through. This arrangement, suggested by that adopted at the Technical School, Hanover, allows free access to all parts of the machinery, and avoids loss of the space occupied by the moving straps. The possibilities of the new laboratories are enormous. With such space and equipment under the able direction of Prof. Schuster, the Owens College should possess one of the finest schools of physics in the world, since every inducement is offered to attract the best students in the country.

The American Electro-Therapeutic Association.—The tenth annual meeting of this Association will be held on September 25th, 26th, and 27th, at the Academy of Medicine, in New York City. Among other features of the convention will be two interesting discussions :—1. "Electricity in Gynecology and the present Reluctance of Gynecologists to use Electricity." 2. "Electricity in Tuberculosis and the present Modes of Treatment." Dr. Walter H. White, of Boston, is the president.

Parliament and Electric Lighting Competition.—We had ventured to hope that Parliament had arrived at a more reasonable stage in its attitude towards certain electrical schemes involving the principle of competition. Events of the past week have, however, turned the reasonable majorities of a few weeks ago into minorities which have led to the rejection of the Dublin Electric Lighting Bill, under which company competition with the Corporation was to be allowed, and the Marylebone Electric Lighting Order, under which competition with the existing supply company would be permitted. The Commons' majority against the Dublin scheme was only 6 votes (168 for, 174 against); that against the second reading of the Marylebone Bill being 28 (119 for, 147 against). In regard to the Dublin matter, it would appear that, however long a Corporation may delay taking steps necessary for the proper development of an electricity undertaking, competition is not to be allowed. The speakers in the Commons debate for the most part failed to appreciate any default upon the part of the Corporation, and the fact that the municipal extension scheme had at last been taken in hand seemed to act as a deterrent from allowing competition. Therefore a Corporation may dilly-dally and wait as long as it likes, and may depend that something will happen to save it, if only by the skin of its teeth, as at Dublin. The Electric Powers Committee have made a rod for the back of neglectful municipal authorities, but the enlightened Commons, in its wisdom, smiles beneficently in the strength of its noble majority of six upon a Corporation which has failed to do its duty. How this decision is to be reconciled with that allowing competition in the City of London, we fail to see. There seems to be all the difference in the world between meting out fair dealing to a company and to a municipality. Whipped up oppositions seem to be responsible for a good deal of Parliamentary wobbling. We hope Parliament will know how to deal with the Power Bills Committee's recommendations if these come before the House again. It is possible to sacrifice too much to the pettifogging and purblind policy of municipal protection.

Kalgoorlie Power Scheme.—In a circular issued to the shareholders it is stated that the directors of the Kalgoorlie Electric Power Syndicate have appointed Mr. G. R. Mair (who since 1888 had been in the employ of the General Electric Company of America, and had been engaged exclusively in work on the application of electrical apparatus for mining purposes) constructing engineer. After inviting tenders for engines from the principal European and American manufacturers, the order was given to Messrs. D. Stewart & Co., Limited, of Glasgow. They are to be vertical cross-compound with Corliss valve gear. The contract for generators has been placed with the General Electric Company of New York, who were the lowest tenderers, and offered apparatus conforming with the specification in all essential points.

Wireless Telegraphy.—Sir Edward Birkbeck writes to the *Times*, under date June 28th, on board K.Y.C. *Meteor*, as follows :—

> It must be almost incredible that, as far as England is concerned, no progress has been made in giving effect to this system of communication between light-vessels and the shore for life-saving, or even commercial, purposes, notwithstanding the successful trials between the East Goodwin light-vessel and the shore, and I am under the impression that even the instruments have been lately removed from that vessel. The Royal Commission of 1892 went most fully into the whole question of cable and wireless communication, and experience has shown that the former is unsatisfactory on account of frequent breakages in winter and great expense. Without advocating especially in favour of our Post Office authorities, or Marconi's system, I contend that it is degrading to have to confess here to the German lifeboat authorities, as well as to the commercial interests, that our country has, as far as communication with light-vessels is concerned, made no progress with wireless telegraphy, though our coast system between lighthouses, coastguard stations, and lifeboat stations has proved a success and of the greatest use. Last week I had personal proof of the working of the wireless system between the Borkum light-vessel 20 miles off from the receiving station on land, and I have an official telegram informing me that at this light-vessel the system is in use for life-saving as well as for commercial purposes. I earnestly trust that the attention of Government will be called to the matter in the House at the first available opportunity.

It is hoped that this letter will have some effect upon the powers that be.

Obituary.—We have to record with regret the death of Mr. Montagu Charles Dent, A.M.I.E.E. (of Messrs. Wallis-Jones & Dent, 36, Great George Street, Westminster), on June 28th, 1900, after a very short illness subsequent to an internal operation. Mr. Dent received his education at Eton, and at King's College, London, and served his time with Messrs. Robey & Co., Lincoln, from 1892 to 1894, and also at the works of the Brush Company, at Loughborough, from 1894 to 1896. During 1896 and part of 1897 he was employed on installation work at Arundel Castle, on central station work at the Wandsworth electric light station, and in the erection of the exhibition plant at the Earl's Court Exhibition. On October 1st, 1898, he joined Mr. Reginald J. Wallis-Jones in partnership as consulting engineers at 36, Great George Street, Westminster, and carried out several important installations of electric light and power plants.

We regret to learn of the death of Mr. Henry Reason, managing director of the Reason Manufacturing Company, of Brighton. A couple of months ago he left, in company with Mr. Arthur Wright, for Brisbane, on some consulting work. At Rockhampton last week a serious accident of some kind, at present undetailed, befel him, and the cablegram intimating this fact was followed a few days later by an announcement of his death. The deceased gentleman was only 37 years of age.

We deeply regret to record the death on 25th ult., at Kroonstadt, of enteric fever, of Ernest Claude Short, Electrical Engineers (Volunteers), in his 25th year.

Presentations.—Mr. J. G. A. Ewing, the Gloucester manager of the National Telephone Company, who has been promoted to the district office at Bristol, has received several handsome presents from Gloucester friends, including a tantalus, silver cigarette case, and silver match box and sovereign case combined. These were presented to him at a send-off smoking concert at the Conservative Club. Mr. Ewing also received a silver-mounted ebony walking stick from the linesmen of the Gloucester post office, and a portmanteau and travelling rug from the members of the Gloucester Comedy Club.

At the Leith Corporation electricity works on Monday Mr. Bryson, the burgh electrical engineer, was presented by his staff with a handsome oak study chair, with silver nameplate attached, on the occasion of his leaving to take up consulting work. Mr. Bryson's new office is at 16, Charlotte Street. A photograph of the staff was also sent to Mrs. Bryson.

Personal.—Mr. Harold J. Robinson, formerly with the Dublin United Tramways Company, has been appointed chief electrical assistant by the Pembroke District Council.

Mr. Frith, B.Sc., has been appointed to the lectureship in chemical engineering at the North Wales College.

Mr. A. H. Howard, who has been for some time manager to W. T. Glover & Co., Limited, the well-known manufacturers of electric cables, has been elected to a seat on the board of directors.

At a meeting of the Electricity Committee of the Corporation last week Mr. A. Ellis, the present general manager of the tramways department and electrical engineer, was offered a salary of £300 per annum as engineer of the tramways, as well as £300 per annum as head of the electricity works. This is an increase of £150 a year. The committee's action is due to Mr. Ellis having recently been appointed by the Cardiff Corporation to the position of general manager of their tramways at a salary of £500 a year.

Electrical Engineering in North Wales.—Principal Reichel, of University College, North Wales, in his review of the work of the past session, points out that at the end of last year the provision for temporary assistants in the electrical and engineering department—hitherto provided by the friends of the college—coming to an end, an effort should be made to secure more permanent provision, and the Drapers' Company, whose liberality had previously been of assistance to the institution, has again stood in the breach, and made a grant of £600 to enable the college to carry on the department for another period of three years.

The Towns' Refuse Problem.—As we go to press there comes to hand, too late for insertion in our "Correspondence" columns, the following letter from Mr. Stanley Clegg, the borough electrical engineer at Darwen:—"I am pleased to see from 'The Writer of the Article's' letter in your last issue, that he is willing to allow that Darwen's destructor does not *yet* fall under his sweeping criticisms of destructors generally. He will no doubt be interested to learn that we are expecting to inangurate a system of electric traction in Darwen this autumn; this will give us a much more 'economical' load for our destructor, and I shall hope later on to be able to give him some *facts* as to our working. Personally, I have no hesitation in stating that perfect combustion of the refuse, and a steadily maintained steam pressure could be obtained, so long as the boiler flues were fairly free, when evaporating water at the rate of 1·62 lbs. from and at 212° F. per pound of refuse."

Visit of American Engineers.—On Monday last the Institution of Civil Engineers extended a cordial welcome to the kindred American and Colonial societies, and made them free of the privileges of the Great George Street Institution. Sir Douglas Fox, the president, addressed the members and visitors, and Colonel Haines and other American gentlemen responded. The proceedings were marked by the warmth and cordiality of the speeches. Afterwards the annual convention of the American Society was held in the lecture hall, and was continued on the following day. On Tuesday afternoon the members visited Windsor Castle by special permission of the Queen, who is in residence there; before their return the leading members of the various societies were introduced to the Queen. Yesterday morning the visitors held a business meeting, and in the evening they were to be received by the President and Council of the English Institution at the Guildhall, by permission of the Corporation. We regret that the "samples" of weather with which our American friends have been favoured have been so unpropitious.

Appointment Vacant.—The Salford Electric Light Committee are wanting an electrical engineer for the lighting and tramways undertakings. The latest date for sending applications to the town clerk is July 14th. See "Official Notices" to-day.

Electric Lighting at Redditch.—The District Council last Tuesday discussed the advisability of using steam or gas engines for the extension of the electric lighting scheme. It was decided that an offer from Messrs. Willans & Robinson to supply gas engines for trial purposes be accepted.

Marriage.—On Wednesday, 27th ult., at Knaresborough Parish Church, Mr. Charles Midgley, city electrical engineer at York, was married to Miss M. E. Simpson. The wedding presents were very numerous.

For Sale.—In a sale notice in our advertisement pages, particulars are given of electrical plant and machinery for which offers are invited at Port Tennant Copper Works, Swansea.

NEW COMPANIES REGISTERED.

Rosling, Appleby & Fynn, Limited (66,319).—This company was registered on June 25th, with a capital of £100,000 in £1 shares (50,000 6 per cent. cumulative preference), to acquire the business now carried on at Trafalgar Works, Bradford, under the style of "Rosling & Appleby," to adopt an agreement with Percy Rosling, Harry W. Appleby and Valere A. Fynn, and to carry on the business of electrical and general engineers, electricians, suppliers of electricity, gas, steam, water and other force, cycle, carriage, and motor car manufacturers, smiths, machine makers, wire drawers, india-rubber and gutta-percha manufacturers, &c. The first subscribers (each with one share) are:—P. Rosling, Trafalgar Works, Bradford, electrical engineer; H. W. Appleby, Ilkley, electrical engineer; V. A. Fynn, 18, Apsley Crescent, Bradford, electrical engineer; R. Lord, 50, Waverley Road, Hoxton Grange, Bradford, clerk; H. O. Enrich, 7, Selborne Villas, Bradford, electrical engineer; P. Milne-Milne, Calverley House, near Leeds, mechanical engineer; and J. Orerend, 114, Midland Road, Bradford, works manager. The number of directors is not to be less than three nor more than 12; the first are Percy Rosling, Harry W. Appleby and Valere A. Fynn; qualification, £1,000; remuneration, £500 per annum, divisible.

Dargue Acetylene Gas Company, Limited (66,325).—This company was registered on June 26th, with a capital of £6,000 in £1 shares, to acquire the business carried on by the Dargue Acetylene Gas and Electrical Company, Limited (incorporated in 1898), at Newcastle-on-Tyne and elsewhere, and to carry on the business of manufacturers and suppliers of, and dealers in acetylene and other gases for the purposes of light, heat, motive power, or otherwise, manufacturers of, and dealers in calcium carbide, gas, electrical, and general engineers, suppliers of electric light, &c. The first subscribers (each with one share) are:—W. H. Dargue, 57, Gray Street, Newcastle-on-Tyne, electrical engineer; H. A. Macfadyen, The Gables, Monkseaton, bank clerk; J. A. Macfadyen, The Gables, Monkseaton, clerk; Mrs. C. A. Macfadyen, The Gables, Monkseaton; R. P. Winter, 16, Market Street, Newcastle-on-Tyne, chartered accountant; T. R. Dargue, 3, St. Nicholas Buildings, Newcastle-on-Tyne, provision importer; and W. M. Pybus, jun., P. O. Chambers, Newcastle-on-Tyne, solicitor. The number of directors is not to be less than two nor more than seven; the first are William H. Dargue and Henry A. Macfadyen; qualification, £100; remuneration, £50 per annum, divisible.

Premier Electric Lamp Company, Limited (66,327).—This company was registered on June 26th, with a capital of £100,000 in £1 shares, to adopt an agreement with the Premier Electric Lamp Syndicate, Limited, to manufacture and deal in lamps, wires, lines, cables, accumulators and appliances, to generate, accumulate and distribute electricity, and to carry on the business of an electric light company in all its branches. The first subscribers (each with one share) are:—Lloyd Higginbotham, Hill Top, Cheadle-Hulme, near Stockport, engineer; James B. Atherton, Manhattan, Gateacre, Liverpool, manufacturer; Henry A. Watson, 4, Rumford Place, Liverpool, merchant; Duncan McKechnie, Eccleston Grange, near Prescot, gentleman; Charles Petrie, 9, Devonshire Road, Princes Park, Liverpool, merchant; Thomas Briggs, The Cedars, Laughan Road, Bowdon, gentleman; and Jacob Atherton, Hurst Park, Prescot, manufacturer. The number of directors is not to be less than two nor more than seven. The subscribers are to appoint the first; qualification, £250; remuneration, £200 each per annum (£250 for the chairman) and a share in the profits.

Electrical Testing Laboratories, Limited (66,329).—This company was registered on June 26th, with a capital of £3,000 in £1 shares, to acquire the Westminster Electrical Testing Laboratories, 14, Great Smith Street, S.W., to adopt an agreement with F. J. Warden-Stevens, and to own and maintain any laboratories or other places where electrical, chemical, or other machinery or apparatus can be tested, calibrated, or standardised. The first subscribers (each with one share) are:—W. W. Norman, Essendine, Woking, secretary; B. G. Battson, Brackenhurst, Woking, architect; E. R. Blundstone, 14, Great Smith Street, S.W., consulting chemist; A. Sharp, 47, Victoria Street, S.W., consulting engineer; S. Hutchinson, 47, Chancery Lane, W.C., solicitor; H. G. Ralton, 54, Thornton Street, Brixton, S.W., clerk; and T. J. Woods, 15, Wylden Street, Forest Hill, S.E., clerk. Registered without articles of association. Registered office, 34, Victoria Street, S.W.

Typewriting Telegraph Corporation, Limited (66,332).—This company was registered on June 26th, with a capital of £100,000 in £1 shares, to adopt an agreement with Recording Telegraphs, Limited, to acquire any patents relating to the generation, storage, and transmission of electricity, or to telegraphy, and telephony, and to manufacture, sell, let on hire, erect, maintain, and deal with recording telegraph instruments and other electrical apparatus, machinery, appliances, and things. The first subscribers (each with one share) are:—R. J. Barrow, 109, Fort Road, Bermondsey, S.E., clerk; A. R. Denton, 35, Queen Victoria Street, E.C., secretary; F. Viller, 14, Kitto Road, S.E., clerk; J. T. Caffrey, 9, Millman Street, W.C., clerk; H. J. Taylor, 40, Greville Road, Walthamstow, clerk; H. Hill, 182, Leander Road, S.W., shorthand writer; and F. Howard, 65, Digby Road, Brownswood Park, N. The number of directors is not to be less than three nor more than seven. The subscribers are to appoint the first, subject to the right of the Exchange Telegraph Company, Limited, to nominate one; qualification, £100; remuneration, £100 each per annum (£150 for the chairman) and a share in the profits.

St. Austell and District Electric Lighting and Power Company, Limited (66,382).—This company was registered on June 27th, with a capital of £10,000 in £1 shares (300 founders'), to adopt an agreement with the United Kingdom Tramway, Light Railway and Electrical Syndicate, Limited, and to carry on the business of an electric lighting company in all its branches. The first subscribers (each with one share) are:—J. M. Coon, Bank Office, St. Austell, engineer; H. Hodge, 20, Fore Street, St. Austell, seed merchant; A. P. Coode, Polcarde, St. Austell, solicitor; E. J. H. Bluett, St. Mary's, Scilly Isles, engineering pupil; H. Tullock, 28, Victoria Street, S.W., retired Major; J. Parnell, Waltham Abbey, Essex, J.P., civil engineer; and W. H. Lawley, 78, Grange Park Road, Leyton, clerk. The subscribers are to appoint the first directors; qualification, £100; remuneration as fixed by the company.

Schattner Electricity Meter Company, Limited (66,427).—This company was registered on June 29th, with a capital of £50,000 in £1 shares (12,500 deferred), to acquire the patents of E. Schattner, F. M. Long, and F. W. Harmer, for inventions relating to electricity meters, to acquire the business now carried on

by the said vendors at Timberhill, Norwich, and to carry on the business of electrical and mechanical engineers, electricians, manufacturers of electricity meters, &c. The first subscribers (each with one share) are:—E. Schattner, Timberhill, Norwich, engineer; F. M. Long, 12, Mile End Road, Norwich, engineer; J. C. Wrist, 27, Noyna Road, Upper Tooting, secretary; R. S. Baill, 78, Elmbourne Road, Upper Tooting, chartered accountant; F. W. Harmer, Oakland House, Cringleford, near Norwich, gentleman; R. J. Wallis-Jones, 6, Hampstead Mansions, Heath Street, N.W., engineer; and A. M. Billington, 27, Eaton Rise, Ealing, engineer. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £250; remuneration, £600 per annum and a share in the profits, divisible.

R. Waygood & Co., Limited (66,410).—This company was registered on June 28th, with a capital of £210,000 in £1 shares (105,000 preference), to acquire the business of a company of the same name, to adopt an agreement with the said old company and its liquidator, and to carry on the business of manufacturers of and dealers in lifting machinery, hydraulic, electrical, mechanical and general engineers, contractors, &c. The first subscribers (each with one share) are:—H. C. Walker, Falmouth Road, S.E., engineer; W. R. Green, Falmouth Road, S.E., engineer; E. P. Okeden, Falmouth Road, S.E., engineer; R. J. White, Cunard Street, Camberwell, mineral water manufacturer; D. W. R. Green, Hillside, West Chislehurst, engineer; M. Lancaster, 10, Ironmonger Lane, E.C., chartered accountant; and C. W. Hildred, 2, Hampton Gardens, Catford, engineer. The number of directors is not to be less than three nor more than seven; the first are H. C. Walker, W. R. Green, C. Day, E. P. Okeden, D. W. R. Green and R. J. White; qualification, £1,000.

Lewisham and District Electric Supply Company, Limited (66,420).—This company was registered on June 29th, with a capital of £10,000 in £1 shares, to carry on at Lewisham, S.E., and elsewhere the business of an electric light company in all its branches, and in particular to construct, lay down, and maintain all necessary mains, cables, wires, lines, accumulators, lamps, plant, machinery, &c. The first subscribers (each with one share) are:—J. Atherton, Hurst Park, Prescot, Lancashire, manufacturer; W. M. M. Forwood, 15, Union Court, Castle Street, Liverpool; solicitor; F. Horne, 44, Loughborough Park, S.W., secretary; G. T. R. Collis, 3, Lewisham Park, traveller; H. Perry, 26, St. Mary's Square, S.E., book-keeper; D. Galer, 11, Ferndale Road, Clapham, S.W., traveller; and A. Purnell, 25, Carlingford Road, N.W., picture dealer. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first.

W. H. Allen & Sons, Limited (66,440).—This company was registered on June 29th, with a capital of £200,000 in £1 shares, to acquire the Queen's Engineering Works, Bedford, with the business carried on there by W. H. Allen, Son & Co., and to carry on the business of mechanical and electrical engineers, electricians, suppliers of electricity for light, heat, motive power, and otherwise, coal and ironmasters, miners, timber and lumber merchants, shipbuilders and owners, and general merchants. The first subscribers (each with one share) are:—E. E. Ford, 61, Dennington Park, N.W., gentleman; F. S. Davis, 106, St. Alban's Road, Seven Kings, writer; J. W. Paget, 48, Arbour Square, Stepney, writer; J. F. Cooke, 45, Rymer Road, Addiscombe, clerk; T. F. Stevens, 37, Sandown Road, South Norwood, gentleman; A. G. Lewis, 47, Park Row, Forest Hill, gentleman; and J. W. Ward, 14, Marney Road, S.W., gentleman. The number of directors is not to be less than two nor more than five. The subscribers are to appoint the first; qualification, £500; remuneration, £2,000 per annum, divisible.

SUPPLY STATION ACCOUNTS.

Chester Corporation Electricity Accounts.

The Chester Corporation have had no cause to regret having, perhaps hesitatingly, taken over into their own hands the electricity supply undertaking, which immediately upon the change improved in all respects, as we fully considered when placing the accounts for 1897 and 1898 before our readers on October 20th last. It was hardly to be expected that similar progress would be shown in 1899, but it will be found that, making due allowance for the enhanced prices ruling last year, the accounts indicate a satisfactory state of affairs.

General Statement.

	1898.	1899.	Increase.
Total capital expenditure ...	£54,772	**£65,766**	£10,994
Number of units sold	473,656	**617,792**	144,136
Total maximum demand kw. ...	350	**529**	179
Gross revenue	£7,665	**£9,607**	£1,942
Gross profit	£4,658	**£4,999**	£341
Average price per unit sold ...	3·77d.	**3·60d.**	– ·17d.

The revenue statement shows that the price received is gradually being reduced, and the consumers have every reason to be satisfied with an average of 3·6d., as compared with 4·5d. in 1897. The gross revenue is rising rapidly; the increase last year over 1898 being twice that of 1898 over 1897.

Revenue Statement.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase
Sale of energy	£7,438	3·77d.	**£9,268**	3·60d.	– ·17d.
Meter rents, &c.	183	·09d.	**251**	·10d.	+ ·01d.
Supply of lamps	44	·02d.	**88**	·03d.	+ ·01d.
Sundry fees, &c.	...	...	...	...	...
Gross revenue ...	£7,665	3·88d.	**£9,607**	3·73d.	– ·15d.

The public lighting at the beginning of the period under review comprised 116 arc lamps and 120 incandescents. The present number is 165 arcs and 206 incandescents. The units generated, &c., may be stated thus:—

	Public lamps.	Private supply.	Total sold.	Used on works.	Total generated
1897 ...	103,311	252,646	355,957	65,522	470,524
1898 ...	147,077	326,579	473,656	71,999	575,131
1899 ...	217,823	399,969	617,792	86,262	763,154

Chester was fortunate in obtaining an extremely low coal bill in 1898, and has therefore, not unnaturally suffered by the great increase in the cost of fuel; the coal bill per unit has gone up as much as 50 per cent., but even at ·45d. is very satisfactory for an output of less than $\frac{3}{4}$ of a million units. "Repairs" are also on the up-grade as might be looked for. Notwithstanding increases in each item of the works cost, Mr. Thursfield ought to be satisfied with a total cost of less than 1½d. per unit.

Cost of Production.

	1898. Gross.	1898. Per unit.	1899. Gross.	1899. Per unit.	Increase.
Coal	£598	·30d.	£1,155	**·45d.**	+ ·15d.
Oil, waste, water and engine room stores	163	·09d.	306	**·12d.**	+ ·03d.
Salaries and wages incurred in generation and distribution and attending public lamps.	875	·44d.	1,157	**·45d.**	+ ·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos and street lamps	370	·19d.	847	**·33d.**	+ ·14d.
Works costs ...	£2,006	1·02d.	£3,465	**1·35d.**	+ ·33d.
Rent, rates and taxes ..	83	·04d.	149	**·06d.**	+ ·02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	654	·33d.	723	**·28d.**	– ·05d.
General establishment charges, stationery and printing, law charges and insurance.	264	·13	271	**·10d.**	– ·03d.
Other expenses	...	...	...	...	...
Total costs ...	£3,007	1·52d.	£4,608	**1·79d.**	+ ·27d.

The reduction in receipts per unit coupled with an increased cost-sheet has prevented a large increase in gross profit, but it is ample to provide a substantial contribution to the reserve fund, and a small amount carried forward.

Profit Statement.

	1898.	1899.
Interest	£1,442	£1,890
Sinking fund for repayments	1,317	1,903
Net profit carried to preliminary expenses	1,053	...
" " reserve fund	846	1,140
" " forward	...	66
Gross profit	£4,658	£4,999

CITY NOTES.

Blackheath and Greenwich District Electric Light Company, Limited.

When our representative presented himself at the meeting of the above company at Cannon Street Hotel on Tuesday he was informed that the proceedings were not open to the Press, and in response to inquiries was informed that there was nothing of special interest transpiring. How correct this was may begathered from the fact that a report of the proceedings appeared in the *Times* and other papers of Wednesday, and as most people who are interested in electricity supply business have been watching the Blackheath Company with considerable interest for some time past, we reprint the *Times* report of the meeting, contenting ourselves with but one remark, and that is, that proposals to issue fresh capital (4½ per cent. debentures) are not always considered matters little importance.

An extraordinary general meeting was held, Sir J. A. Willox, M.P., in the chair, to consider resolutions for increasing the capital of the company to £300,000 by the creation of 150,000 new shares of £1

each entitled to receive out of the profits a fixed cumulative preferential dividend at the rate of 7 per cent. per annum, and authorising the directors, without prejudice to the powers vested in them, to create and issue £120,000 of debenture stock carrying 4½ per cent. per annum interest. The chairman, in proposing the resolutions, reminded the shareholders that when he last addressed them, the company had not commenced the supply of electricity from their own works. They had, however, overcome their initial difficulties since, and a good many orders, both for light and power, had been secured. When the company began their own supply in February, the number of lamps connected was equivalent to 5,900 8-c.p., whereas at the present time 10,000 lamps were connected, and as the longer nights approached, the directors anticipated that this rate of progress would be accelerated. A considerable amount of energy to industrial works was already being supplied by the company, and contracts had been completed for still larger supplies of power for manufacturing purposes. The total expenditure to date had been £128,000, but there were other charges to be brought in. To meet these liabilities, and to extend their area of supply, for which powers had been obtained, additional capital was required. After much deliberation, the board recommended the issue of £100,000 of mortgage debenture stock bearing 4½ per cent. per annum interest. It would be repayable in 1931, and would be redeemable at the company's option at 105 after it had run for 10 years. Under certain restrictions the stock might be converted into an equivalent amount of 7 per cent. cumulative preference shares, but the option of making this conversion practically attached to a period of five years only. Allotments of the stock would be made to the shareholders in priority to other applicants. Some shareholders had assumed that the directors proposed to issue both mortgage debentures and preference shares, but they had no such intention. What the board proposed was to issue £100,000 of debenture stock, and if the debentures were converted into preference shares, such debentures would *ipso facto* be cancelled.

Mr. H. W. Bowden seconded the motion.

A discussion followed, and in the result the Chairman promised that the board would issue no preference shares, except for the purpose of exchange, without first consulting the shareholders. The resolutions were approved.

The United River Plate Telephone Company.

At the annual meeting of this company, held at Winchester House on Tuesday, Mr. J. Irving Courtenay, the chairman, in moving the adoption of the report, said that the continued improvement anticipated at the last meeting has been fully realised. The fluctuations in the gold premium had been slight, the Government scheme for maintaining the minimum gold premium at 127·30 having, so far, met with a measure of success. The number of subscribers was now approaching 9,000, the increase being 50 per cent. greater than during the previous year. The new central office building was completed last December. Substantial progress has been made with the important work of laying underground plant. It is essential to the company's best interests to extend the system of subways as much as possible. In regard to the credit side of the balance-sheet, the addition of £23,154 capital outlay was due to the expenditure on underground plant, switchboards, &c. The item of conversion of the old 7 per cent. debentures had now disappeared from the balance-sheet, the balance outstanding (£5,504 6s. 8d.) having been written off the depreciation fund. Sundry debtors, £8,222, were some £1,600 more, owing chiefly to advance payments on materials ordered which are carrying interest. Investments were at a higher figure. The stock of instruments and materials in the River Plate, which stand at £1,000 more than last year, consists almost entirely of new material. The remaining items of bills receivable and cash at bankers, in hand, and at call, make a total cash balance of £34,406. On the debit side, the subscribed share capital was increased by the issue of £83,195 preference shares; the debenture stock remained at £179,947. Sundry creditors, £5,387, were about £500 less. The reserve fund, £20,000, is to be increased to £40,000. This was a very satisfactory item. The depreciation fund, £3,495, is the remainder, after writing off the balance standing against the conversion of the old 7 per cent. debentures, which were refunded as 5 per cent. debentures. The cost of their conversion, originally amounting to £29,209, had now been wholly met by appropriations from year to year from reserves. The gross revenue in the River Plate was this year £101,169, an increase of nearly £16,000 over last year. The expenses on the other side of the account were maintenance charges in the River Plate, £45,042, an increase of £3,000; London expenses, an increase of £2,353; and other items. The balance of profit for the year was £35,179; this was after deducting debenture interest and dividends paid on the preference and ordinary shares at the end of December, the latter amounting to £7,250, so that the total net profit for the year was £42,429, as compared with £33,333 last year. In dealing with the appropriation of this sum, the board had considered it desirable to continue the policy of building up a substantial reserve, and therefore propose that the sum of £5,000 should be put to depreciation fund, and £20,000 to reserve fund. After paying a further dividend on the ordinary shares of 4½ per cent., making a total return for the year of 7 per cent., there remained the sum of £5,019 to carry forward. As to capital expenditure, they must recognise the necessity of adding largely to their capital outlay in order to properly equip their telephone plant with the latest improvements, and thus render it effective to meet not only the business already existing, but the anticipated continual increase in the future. The managing director, Mr. F. W. Jones, spent the whole of last winter in Buenos Ayres. He was greatly impressed with the prospects for rapid growth of the business, and of the great need of putting as much of the trunk system underground as possible, in order to efficiently prepare for that growth. The company's overhead wires were already so numerous and so close together that it became more and more difficult to avoid induction, and the obvious remedy was to have as extended an underground system as possible. A substantial beginning of this necessary work had been already made, but much remained to be done, and in order to provide for a scheme which should at once be efficient and economical, it was essential to have the requisite capital at command. The subject had engaged the close consideration of the directors at home and of the management in Buenos Ayres. They agreed that delay in pushing on with this most essential work was to be avoided at all costs. It had, therefore, been decided to at once issue the balance of the preference share capital, authorised last year. Of the authorised amount of £200,000, half was then offered to the public, with the result that £83,195 was subscribed. It was now intended to offer the remaining £116,805. With this new capital, the directors will undertake improvements in the plant which will enable them to give a telephone service equal to any, resulting in a great increase in revenue.

Mr. Frederick Green seconded the adoption of the report, and after a few comments had been offered by a shareholder, the motion was carried. The retiring directors and auditors having been re-elected, the usual vote of thanks closed the meeting.

The Electric Construction Company, Limited.

The directors' report to be submitted to the seventh annual general meeting on Thursday, July 12th, at Winchester House, at 12 noon, reads as follows:—

"The profit of the year ending May 31st last, including the balance of £1,441 6s. 2d. brought forward, is £21,729 1 9

which your directors recommend be appropriated as follows, viz.:—

In providing a dividend of 7 per cent. on the preference shares (to be paid on July 31st next)	£3,500 0 0	
and a dividend of 6 per cent. on the ordinary shares (one-half to be paid on July 31st next, and one-half on January 31st, 1901)	13,452 0 0	
		16,952 0 0
The surplus of		£4,777 1 9

to be carried to next year's accounts.

"The buildings and plant have been thoroughly maintained, and £5,000, as usual, has been credited to depreciation account, which now amounts to £33,000. The buildings of the extensions referred to in last year's report, have been finished, and the shops are now being equipped with the latest labour-saving tools and appliances, capable of turning out economically and with dispatch the largest electrical machinery that may be required. Among the more important works of last year may be mentioned the power house and line equipment, with British machinery and appliances throughout, of the extensions of the City and South London Electric Railway. The works are well supplied with orders at remunerative prices; the relations with all classes of employés are thoroughly harmonious, and the directors have had much pleasure in awarding the usual bonus in recognition of good service. It has been considered expedient to foreclose the mortgage on the Madras Electric Tramways and to acquire the undertaking, but it is not intended that this should be a permanent investment. Meanwhile the working of the tramway yields a moderate return on the cost, and the traffic is developing satisfactorily. The compensation paid under the Workmen's Compensation (1897) Act is, for the year, less than £20, but £150 of last year's profit has been credited to the fund to meet such claims. The directors who retire by rotation at the general meeting (and who are eligible for re-election) are Sir Daniel Cooper and Sir James Pender. The auditors, Messrs. James Meston and Co., offer themselves for re-election."

Thomas Parker, Limited.

The annual meeting of this company was held at Wolverhampton last Friday, Mr. C. T. Mander presiding.

The Chairman moved the adoption of the report. He remarked that it was only when dividends of 1½ per cent. were to be declared, or none at all, that shareholders were likely to attend and ask questions. This year, as they saw from the report, it was proposed to declare a dividend of 10 per cent., which he considered was quite satisfactory, in fact, he would not think of declaring a larger one for some time to come. The fact that they were able to take over £5,000 to the reserve was also satisfactory. They had not made so much gross profit during the year as in the previous one, and as they knew that was hardly to be expected, because the price of materials of all sorts had gone up, and they had not thought it policy to increase the price of their manufactures, dynamos, &c., in a like proportion. He thought, however, the 10 per cent. dividend, and the £5,000 going to the reserve, would be considered as satisfactory.

Mr. T. Parker seconded the motion, which was adopted, as was also a formal resolution declaring the 10 per cent. dividend.

The directors and auditors were re-elected.

The West African Telegraph Company.

The Marquis of Tweeddale presided at this company's meeting last Friday. In moving the adoption of the report said that revenue for the year ended December 31st amounted to £77,008, an increase of £11,486. That increase was principally due to exceptional traffic with South Africa in consequence of the war. This increase was £11,498. On the other hand, there was an increase in the rent of cables of £563, and a reduction in the loss on exchange of £419. The total working expenses were £20,298, or a decrease of £1,229, made up of several items. The expenses attending repairs and renewals were £11,482, a decrease of £6,236. Since the date of the accounts they had had to incur the cost of extensive repairs to Bathurst-Dakar and the St. Thomé-Loanda cables. The net result of the year's working was £23,298 profit, of which £23,000 would be placed to reserve and the balance carried forward to next year. The revenue included £12,000 in respect of the subsidy due from the French Government for 1899, and the non-payment of that amount had been provided for by transferring £12,000 from the general reserve fund to a special fund pending a settlement. The delay in the settlement of that item was due to the unsettled state of politics in France and the frequent changes of ministers. The board hoped that before long some arrangement would be come to on an equitable basis. The general reserve fund now stands at £28,188, which, taking all the circumstances into consideration, was far from adequate for the requirements of the company. The question of dividends must, therefore, be deferred until they were in a position to replace the heavy withdrawal which they had been obliged to make out of the fund.

Sir Henry Mance seconded the adoption of the report, which was unanimously carried.

The Chairman then explained briefly the proposed staff pension fund, under which the staff will contribute 4 per cent. of their salaries and the company a like amount. The cost to the company will be about £500 per annum. The scheme was approved, and the necessary papers for carrying it out are to be prepared.

The Hon. A. G. Brodrick was re-elected a director, and Messrs. Deloitte, Dever, Griffiths & Co., auditors.

The Bastian Meter Company, Limited.

The third ordinary general meeting was held on Thursday last week at the offices, Kentish Town, under the presidency of Mr. C. Orme Bastian, who, in moving the adoption of the report and accounts, said that the results of the past year could be summed up in two words, viz., "rapid progress." They had converted a loss of £2,000 shown last year into a profit of nearly £400 this year. During the past three weeks the orders for meters were larger than for the whole of the first six months of the year, and therefore the directors were justified in taking a sanguine view as to the future. They were glad to be able to pay the preference dividend in full, and he believed that the ordinary shareholders would soon receive ample reward for their patience. Taken altogether, he thought the shareholders had reason to look forward with unbounded confidence to the future of the company.

Mr. Umberto Ciantar seconded the adoption of the report, which was unanimously agreed to.

Greenwood & Batley, Limited.

The report for the year ended March 31st, to be presented at the meeting to be held in London on 10th inst., states that, after providing for interest on the debentures and for expenses of management, writing off £1,500 for depreciation on buildings and plant, and making due provision for doubtful accounts and allowances, the accounts show, with £2,956 brought forward, an amount available of £11,785. The directors recommend out of this sum dividends at the rate of 7 per cent. per annum on preference and of 2½ per cent. per annum on the ordinary share capital, leaving £463 to be carried forward. The buildings, plant, and machinery have been maintained in efficient working order and condition, £9,000 having been expended during the year on maintenance account and charged to revenue. This amount is exceptionally heavy, as advantage was taken during the first half of the year, when the cartridge department was practically without orders, to thoroughly overhaul and repair the cartridge-making plant, which since January last has been working to its utmost capacity on Government contracts.

Elmore's German and Austro-Hungarian Metal Company.

We read in the *Financial Times*:—

The secretary of Elmore's German and Austro-Hungarian Metal Company, Limited, has issued a circular to the shareholders stating that the demand for goods produced by the company at Schladern rendered it imperative to increase the tank capacity of the factory, and the directors have erected a new tank room and have commenced the installation of 32 new tanks, which are now rapidly approaching completion. The extension is necessary also in view of the fact that the German Government has decided to largely augment its Navy, and in addition to meeting the demands of the trade, which are increasing rapidly, the company, as practically the sole contractors to the Navy, must be in a position to cope with the increased demands of the naval dockyards. The directors have given careful consideration as to the best means of raising further capital in order to provide for the copper required for the increased output (to the value of over £10,000), and they have come to the conclusion that it would be advantageous to the company to raise the money by a further issue of preference shares, and although they are reluctant to increase the number of shares issued which participate in the nine-tenths of the net profit, each shareholder who takes his proportion of one new share for every five that he now holds will retain his full interest in the company. It is proposed to issue 5,000 shares at par.

Electric Power Storage Company, Limited.

The directors' report to May 31st, 1900, reads as follows:—

The profit for the year is £5,309 4s. 3d., and the balance brought forward from last year, £554 12s. 11d., together amounting to £5,863 17s. 2d. Of this, £243 1s. 1d. has been carried to reserve fund, and £1,000 to contingent fund; and the directors recommend the payment of a dividend of 5 per cent. on the ordinary share capital, which will absorb a further £4,362 8s. 5d., leaving £258 7s. 9d. to be carried forward. The company's buildings, plant, tools, &c., have been maintained in thorough repair and condition at a cost of £2,894 10s. 2d., which sum has been provided out of revenue. The directors are glad to state that the demand for the E.P.S. batteries increases year by year, and the recent extension of the works is being fully utilised. The orders on hand are larger in amount than at any previous time, and include several for tramway and power stations, the special type manufactured by the company for this purpose having met with the entire approval of engineers. The development of the business has necessitated the introduction of further working capital, and a call of £1 per share has been made during the year on 3,132 ordinary shares on which only £3 per share had been previously paid. The directors regret to announce the death of Mr. Frank King, lately a director, and for many years manager of the company. Mr. King's death in August last removed one of the pioneers of the storage battery industry.

Edmundson's Electricity Corporation, Limited.

The directors' report for the year ended March 31st, 1900, to be presented at the third annual meeting at Broad Sanctuary Chambers, S.W. to-day (Friday), reads as follows:—"The directors beg to submit their third annual report and statement of accounts. Including the sum of £2,572 5s. brought forward from last year, the net profit, after payment of debenture interest, amounts to £19,832 6s. 9d. The directors recommend that £5,000 be written off goodwill, and that a dividend of 6 per cent. be paid upon the ordinary and deferred shares for the year ended March 31st, 1900, amounting to £10,674 4s. 2d., leaving a sum of £4,152 2s. 7d. to be carried forward to the next account. The electric lighting stations at Folkestone, Winchester, Woolwich, Bromley (Kent), High Wycombe, Salisbury, Ventnor, Chislehurst, and Newmarket, all of which were completed a year ago, have been working satisfactorily, and dividends have been paid to the shareholders of the five first-mentioned companies as the result of the first year's working. These results, obtained at so early a stage, must be looked upon as most encouraging, and confirm the belief of the directors that electric lighting in such towns will prove a profitable investment. During the year the stations at Guernsey and Alderley Edge have been completed and are now working. Details showing the progress of the various stations are given in the accompanying schedule. Work has been commenced for central stations at Montrose, Brechin, Melton Mowbray, Lymington, Sandown, Shanklin, Newport and Cowes, and Parliamentary powers are being obtained, with the consent of the local authorities, for several other towns. A considerable number of private installations for country houses, &c., have been carried out, and this department of the business has been well maintained. Investments in local companies in which the corporation is interested have been taken in the balance-sheet at cost price. During the year 9,400 ordinary £5 shares, being the balance of authorised capital, have been issued and fully paid up. Further capital will be required for the works in progress, and the directors recommend that the nominal capital of the company be increased to £400,000 by the addition of 40,000 shares of £5 each, and they propose that £100,000 should be issued as 6 per cent. preference shares, reserving the other £100,000 for issue at a future time. One of the directors, Mr. W. R. Davies, retires by rotation, and is eligible for re-election. The auditor, Mr. W. H. May, retires, and offers himself for re-election."

Central Stations Working.

Name of town.	Number of 8-c.p. lamps connected. June, 1899.	June, 1900.	Capital expended to Dec. 31st, 1899.	Remarks and financial results to December 31st, 1899.
Folkestone ..	13,000	20,600	£62,968	Dividend of 4 % paid on ordinary shares.
Woolwich ..	6,750	12,000	35,727	2½ % dividend paid on ordinary shares after paying debenture interest.
Winchester ..	6,500	11,500	30,474	2½ % dividend paid on ordinary shares after paying debenture interest.
High Wycombe	3,500	12,000	32,303	2½ % dividend paid on ordinary shares after paying debenture interest. There is an increasing demand for motive power in this area.
Bromley (Kent)	4,050	10,200	43,156	2½ % dividend paid on ordinary shares after paying debenture interest. The Chislehurst Company is supplied from this station in bulk.
Salisbury ..	3,000	7,900	27,206	Earnings were equal to 2½ % on capital expended, but no dividend was paid.
Newmarket ..	2,950	5,800	22,561	Stations open 9 to 10 months, resulting in a small profit.
Ventnor ..	1,100	5,400	26,175	
Chislehurst ..	2,100	4,200	17,359	
Alderley Edge	—	1,714	16,074	Station open five months. Progress has so far been slow.
Guernsey ..	—	5,000	13,366	Station started work in May, 1900. The applications for light are very satisfactory.

Central Stations in Progress.

Montrose and Brechin.—Work in connection with these towns has been retarded owing to delay in the transfer of provisional orders, but is now being proceeded with.

Lymington.—Works are in course of construction, and it is expected will be opened before the end of the year. A contract has been obtained for lighting all the streets, and applications for private lights are coming in well.

Melton Mowbray.—Works are in course of construction, and the station will be open in a few months. Applications for lights are coming in freely.

Sandown and Shanklin.—These two towns will be supplied from one station, which will be completed in a few months. There is every prospect of a good demand for light.

Newport and Cowes.—It is proposed to supply these two towns from a single station, and a suitable site has been purchased and works will shortly be commenced.

Prospectuses.

A prospectus of R. Waygood & Co., Limited, has been in circulation this week. In order to cope with the rapid expansion of the company's business reconstruction became necessary, and an issue on broader lines to the public was resolved upon. The company, as reconstructed, has a nominal share capital of £210,000, half of which is in 6 per cent. preference shares, and half in ordinary shares of £1 each. The vendors of this old-established lift and crane manufacturing and general engineering business take one-third of each kind of shares in part payment of purchase money, and the remaining have now been offered for public subscription. In addition to their £70,000 in shares the vendors take £120,000 in cash or shares. The average annual profits for the years ended March, 1898 (engineering strike), 1899, and 1900 have been £18,453. The list was to close yesterday (Thursday).

To-day the subscription list will close in an issue of first mortgage 4½ per cent. debenture bonds, and 6 per cent. cumulative preference shares in Rosling, Appleby & Fynn, Limited, electrical engineers, of Bradford. The present issue is £15,000 debentures, and £15,000 preference capital. The company was formed with a nominal share capital of £100,000, to acquire as a going concern the business of Messrs. Rosling & Appleby, a name perfectly familiar to readers of the Electrical Review. Mr. Fynn joined the company in 1899, and his experience in power transmission and electric traction work are expected to prove of great value to the business. The company will have the exclusive right to numerous patents taken out by Mr. Fynn, and these are detailed in the prospectus. Messrs. Rosling, Appleby & Fynn, the vendors, take £27,000 in ordinary shares as their consideration, and the company pays the liabilities of the vendor firm, amounting to £11,391. Out of the cash provided by this issue, land will be bought, and the erection of new works with additional plant will be arranged for at a cost of about £14,500. The balance available for additional working capital will be £4,108. The profits for the years 1898 and 1899 are £4,046 and £4,518 respectively, but these figures do not cover interest on capital or loans, remuneration of the partners, nor extra commission paid to Mr. Fynn.

Stock Exchange Notices.—Wednesday, July 11th, has been appointed a special settling day in Alliance Electrical Company, Limited.—70,000 5 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 70,000. Edison and Swan United Electric Light Company, Limited.—Fully and partly paid provisional certificates for £100,000 5 per cent. second debenture stock. The Alliance securities are also to be officially quoted. Application has been made to the Stock Exchange committee to allow the following to be quoted in the Official List:—Kensington and Knightsbridge Electric Lighting Company, Limited—15,000 ordinary shares of £5 each, fully paid, 10,000 first preference 6 per cent. shares of £5 each, 10,000 second preference 5 per cent. shares of £5 each, and £90,000 4 per cent. debenture stock.

The Giffre Electro-Chemical and Power Company, Limited.—An extraordinary general meeting of the shareholders of this company was held on Wednesday at the offices, 11, Cornhill, under the presidency of Mr. E. Sawyer, when a resolution, making a slight alteration in one of the articles, which was passed at the annual meeting held on June 18th, was confirmed.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending June 30th, 1900, were £724 1s. 9d.; receipts for corresponding period, 1899 (6 days), £609 13s.; aggregate for half-year to date, £10,125 17s. 2d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 29th, 1900, were £3,148 8s. 7d.; corresponding period, 1899, £3,214 11s. 7d.; decrease, £66 3s.

The City and South London Railway Company.—The receipts for the week ending July 1st, 1900, £1,490; July 2nd, 1899, £980; increase, £510. Total receipts for half-year, 1900, to date, £33,724; corresponding period, 1899, £26,894; increase, £6,830. Miles open, 1900, 4½; 1899, 3½.

The Dover Corporation Tramways.—The receipts for the week ending June 30th, 1900, were £213 0s. 3d.; July 1st, 1899, £210 14s. 6d.; increase, £2 5s. 9d. Total receipts to date, 1900, £4,501 9s. 9d.½; corresponding period, 1899, £4,231 18s. 6d.; increase, £269 11s. 3½d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,987; 1899, 4,476. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, June 29th, 1900, were as follows:—D. U. T. Co., horse cars, £59 4s. 8d.; ditto, electric cars, £3,602 4s. 6d.; D. S. D. Co., electric cars, £963 9s. 5d.; total, £4,624 18s. 7d; corresponding week last year—D. U. T. Co., horse cars, £2,232 19s. 3d.; ditto, electric cars, £1,317 6s. 6d.; D. S. D. Co., electric cars, £1,036 12s. 5d.; total, £4,586 18s. 2d.; increase, £38 0s. 5d. Aggregate to date, £108,626 12s.; aggregate to date last year, £94,915 4s.; increase to date, £13,711 8s. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 1st, 1900, were £1,682; corresponding week last year, £1,462; increase, £220. Total receipts to date, 1900, £37,502; corresponding period, 1899, £36,192; increase, £1,310. Miles open, 6 m. 57 chains.

STOCKS AND SHARES.

Wednesday Evening.

The Transvaal war is almost forgotten, speaking figuratively, as a factor in Stock Exchange markets. Everything is now made to hang upon the crisis in China. Against that not even a cheaper money market avails to help business along in the House, and its shadow is paralysing all investment departments. It is no uncommon thing to hear a broker declare nowadays that he has not booked a bargain all day, and under the depressing influences of outside politics and inside stagnation the Stock Exchange is condering itself fortunate in having to face comparatively slight declines in the value of its securities.

Another thing which is counteracting the ease of Lombard Street, is the remarkable number of trustee and Colonial issues which have recently been spread before the investor. With Australian Governments offering 3 per cent. loans at 95, there is not much inducement for the investor to seek openings for his capital in the markets, and the absence of the monied classes acts, of course, unfavourably upon the more gilt-edged securities of the House. But Electric Supply Debentures are well maintained. Out of the quartette of falls which we record in this section, three of them are occasioned by the marking of the stocks *ex* dividend. The other, a drop of 2 per cent. in City of London 5 per cent. Debenture stock, is the natural sequence of the threatened issue of more Debenture stock by the company. A meeting of the shareholders is to be held on Wednesday next in order that a resolution may be passed empowering the directors to borrow another £400,000. The Ordinary shares are very little affected in price.

Westminsters, after a drop of nearly a pound, hardened up again. The market in these has now quieted down after the new shares have been satisfactorily disposed of. We are glad to notice that the fatuous demand of Somerset House with regard to the filling up of renunciation-forms before they can become negotiable, has been withdrawn. We strongly protested against its adoption three weeks ago, and it is satisfactory news to every investor to learn of its suppression.

Edmundsons are unaffected by the declaration of the dividend, which came up to market anticipations. A good demand for Metropolitans has lifted the price to the extent of £1, the quotation now standing at 15.

After the opening of the Central London Railway by the Prince of Wales the flutter of buying the shares ceased, and the price has fallen 7s., allowing for the deduction of the dividend. Some of the speculative division who had laid in Central London Deferred half-shares quickly cleared out, and the result is a small decline in price, but the Preferred, on the other hand, are *ex* dividend and unchanged in price, making a practical rise of 1s. 6d., the amount of the distribution. A very strong Stock Exchange tip to buy Central Londons is being widely circulated. We hardly see the reason for it, but trust that the rise will take place for the sake of the patient original shareholders.

City and South London stock has relapsed on the lift accident at London Bridge, which is likely to cost the company compensation that it can ill afford, besides tending to make the public nervous of travelling on the line, and thereby reducing traffic receipts. In sympathy with the fall in City and South London, Waterloo and City Ordinary was marked down a brace of points. Probably this fall in price was brought about, as a matter of fact, by a suspected seller, who was busily unloading London and South-Western stock at the end of last week.

Amongst other miscellaneous items we may remark that the latest emission of Calcutta Tramway shares commands 10s. premium.

British Electric Traction Ordinary are now quoted *ex* both dividend and rights; the Preference still carry the dividend of 6s. per share, but not the rights. The new shares are, of course, to some extent pulling down the prices of the old. A brisk market is now existent in the fractions, the Ordinary being quoted at 8s., and the Preference at 4s. per fraction.

In throwing out the Dublin Electric Lighting Company's Bill, Parliament acted in accordance with most Stock Exchange wishes, but its rejection of the Electric Lighting Provisional Order (No. 11) on Tuesday night was not wholly welcomed in the House. Metropolitan shares, however, went better on the action of Parliament, and the proprietors will breathe more freely now that competition is staved off for some time.

The Chinese crisis has so far failed to depress the telegraph market to any extent. Eastern Extensions have hardened, and the latest issue of shares is quoted at 1¼ premium. The company will be considerably more affected by the Far Eastern question than its contemporary, the Eastern Telegraph, but shareholders should not part with their holdings at present. Very little animation prevails in the telegraph department as a whole, and the Anglo-American stocks are hardly mentioned.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, June 27th.	Closing Quotation, July 4th.	Business done during week ended July 4th, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	99 —103	...	...
125,000	Amazon Telegraph 5 % Debs., Nos. 1 to 1,250 Red. ...	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	60 — 65	60 — 63	£0	...
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	113½—114½	113½—114½	114½	113½
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	12½— 13	12¾— 13¼	13⅛	12⅞
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	3 %	...	2½— 3½	2½— 3½	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175 xd	...	...
1,563,078£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	101 —103	103½	102½
16,000	Cuba Telegraph	10	7 %	8 %	7 %	6½— 7½	6½— 7½	6½	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	15½— 16½	15½— 16½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	101 —105%	100 —104% xd	...	...
60,710£	Direct United States Cable	20	3½%	3½%	3 %	11½— 12	11½— 12	...	...
111,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	99 —102 xd	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	148 —153	148 —153	151	149½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	97 —100	97 —100	99⅝	97
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	111 —116	111 —116	114	112
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14⅜— 15¼	14⅜— 15¼	15¼	14⅞
6,700£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	100 —103	... — ...	...	...
26,600£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	... — ...	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	112 —117	112 —117	112	...
800,000£	Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 8,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	...	...	...	100 -103%	100 —103%	100½	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	5¼%	11½— 11⅝	11½— 11⅝	11⅝	11⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15 — 15½	15 — 15½	15 3/16	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	12½%	...	32 — 34	32 — 34	...	...
84,300	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	98 —101 xd	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	53 — 57	53 — 57	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	105 —108	105 —108	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	4 %	4 %	2½%	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	5 — 5½	5 — 5½	5	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 15	13 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5 — 5½	5 — 5½	...	...
2,000,000£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	98 —101	98 —101 xd	100	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1⅛	⅞— 1⅛	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	102 —105	100 —103 xd	...	...
11,889	Reuter's	8	5 %	5 %	5 %	7½— 8½	7½ — 8½	8½	7⅞
3,881	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	127	...
58,000	United River Plate Telephone	5	5 %	6 %	7 %	4¾— 5¼	5 — 5½	5⅛	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	5 — 5½	5 — 5½xd	...	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	105 —108	104 —107 xd	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	97 —100	97 —100	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	¼— 1	¼— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	100 —103	99 —102 xd	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	102 —105	... — ...	...	...
207,930	Western Telegraph, Ltd., Nos. 1—207,930	10	7 %	7 %	...	14⅜— 15½	14⅜— 15½xd	15	14⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	105 —108	103 —106	...	...
88,321	West India and Panama Telegraph	10	¾%	2 %	⅝ %	⅝— ⅞	⅝— ⅞	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	6½— 7½	6½— 7½	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	6 — 7	6 — 7	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	...	...	104 —107	102 —105 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	6 %	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	...	...	8½— 9½	8½— 9½	...	...
50,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	9½ — 10½	9½ — 10½	10	9⅝
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	6 %	6 %	6 %	6½— 7½	6 — 7	6⅞	...
150,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	...	...	107 —110	107 —110	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	10 %	6 %	4 %	8½ — 9½	8½ — 9½	8⅞	8 1/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	12½— 13½	12½— 13½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	124 —129	122 —127 xd	122⅜	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	4 %	9 — 10	9 — 10	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	11½— 12½	11½— 12½	12⅛	12
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	110 — 113	108 —111 xd	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4½— 5	4½— 5	4⅝	...
75,000	Do. do. 4½ % 1st Mort. Deb. Stock ...	100	...	...	...	101 —104	101 —104	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	1 — 1½	1 — 1½	1½	1½
49,840	Do. do. do. 6 % Pref.	5	...	6 %	...	4 — 4½	4 — 4½	4 1/16	4
250,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	98 —100	98 —100	...	...
85,000	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	5 %	13½ - 14½	14½ - 15½	15	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	...	...	113 —116	111 —114 xd	...	...
220,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	97 — 99	96 — 98 xd	...	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	16 — 17	15½ — 16 xd	...	...
40,000	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	...	...
30,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8½ — 9½	8½ — 9½	...	...
12,000	Smithfield Market Elect. Supply, Ord.	5	...	...	...	2 — 2½	2 — 2¼	...	...
50,000	Do. do. 4 % Deb.	100	...	...	...	85 — 95	85 — 95	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3¼ — 4¼	3¾ — 4¼	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	12 %	12 %	13 %	11 — 12	11 — 12	11⅝	11⅜

* Subject to Founders Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES.—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation June 27th.	Closing Quotation July 4th	Business done week ended July 4th, 1900. Highest.	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	20 %	...	2⅜— 3½	2⅜— 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	96 —101	96 —101	...	...
80,000	British Electric Traction	10	...	6 %	...	16 — 17	14 — 15	14 1/16	14 1/4
50,000	Do. do. 6 % Cum. Pref.	10	...	...	...	12½— 13½	12½— 13	12 7/8	12½
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	123 —126	123 —126	...	...
85,000	†British Electric Works Co., Ord. £1 shares, 50,001—135,000	...	...	...	...	⅞— 1	¾— ⅞	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000 ...	...	...	...	...	1 1/16— 1 1/16	1 1/16— 1 1/16	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	99 —101	97 — 99 xd	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	15 %	15 %	20 %	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6 — 6½	6 — 6½	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	3 %	5 %	...	1⅝— 1⅞	1⅝— ⅞	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2 — 2¼	2 — 2¼	...	...
125,000	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —114	109 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —105	101 —103 xd	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	15 %	13½— 14½	13½— 14½	13⅝	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 5⅝xd	5⅝	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —116	110 —114 xd	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	10½— 10¾	9¾ — 10½xd	10¾	9 7/8
61,033	Do. do. Pref. half-shares	5	...	...	...	4¾— 5¼	4¾— 5¼xd	5 1/16	4 15/16
71,447	Do. do. Def. do.	5	...	...	...	5¼— 5⅝	4⅝— 5¼xd	5¼	4 15/16
855,000	City and South London Railway	Stock	1⅝%	2⅛%	1⅝%	65 — 68	64 — 66	66	...
37,500	Do. do. Ord. shares, Nos. 22,501 to 60,000	10	...	...	...	6 — 7	6 — 7	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	6 %	...	3½— 4	3½— 4	3 1/16	3⅝
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 103	98 —101 xd	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	2 — 2⅛	2 — 2⅛	2 1/16	2
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	...	3½— 4½	3½— 4½	4 1/16	4
344,028	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	93 — 95	91 — 93 xd	92	91
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	...	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
9,600	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 11	10 — 11	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	15 %	13 — 14	13½— 14½	14	13⅜
30,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5¼— 5⅜	5¼— 5⅜	5¼	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	...	...	110 —114	110 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21½	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —103	100 —103	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3½%	9½— 9⅝	8 9/16— 8 11/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13½	13½— 13½	...	...
37,850	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	35 — 39	35 — 39	38½	37¼
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	101 —104 xd	...	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000 ...	5	...	8 %	12 %	10½— 11½	10½— 11½	...	...
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½— 6	5½— 6	...	...
540,000	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	100 —103	98 —101	100	99

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 104—106.
National Electric Free Wiring, 12/6 paid. ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 17½—18½.
Do. do. Pref. (£10 pd.), 10—11.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 %, £5 (fully paid), 7 —7½. Debentures, 102—104. Dividend, 1899, on Ordinary Shares 11 %.
*T. Parker, £10 (fully paid), 17½.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (June 14th, 1900).

MARKET QUOTATIONS, Wednesday, July 4th.

CHEMICALS, &c.	This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	39/-	39/-	..
a Ammonia, Muriate (crystal) .. per ton	£33	£33	..
a " " .. .. per ton	£30	£30	..
a Bleaching powder .. .. per ton	£7	£7	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£17	£17	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£25 10	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2,6	2/6	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£10 15	£10 15	..
a " Crystals .. .. .. per ton	£8	£8	..
a " Bichromate, casks .. per lb.	3½d.	3½d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£234	£234	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£80 to £150	£80 to £150	..
c Brass (rolled metal 2' to 12') basis per lb.	7¾d.	7¾d.	..
c " Tube (brazed) .. .. per lb.	10d.	10d.	..
c " " (solid drawn) .. per lb.	8¼d.	8¼d.	..
c " Wire, basis .. .. per lb.	8½d.	8½d.	..
c Copper Tubes (brazed) .. .. per lb.	11½d.	11½d.	..
c " " (solid drawn) .. per lb.	11d.	11d.	..
Copper Bars (best selected) .. per ton	£83	£85	£2 dec.

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
g Copper Sheet .. .. .. per ton	£83	£83	..
g " Rod .. .. .. per ton	£83	£85	£2 dec.
e " (Electrolytic) Bars .. per ton	£91	£91	..
e " " Sheets.. per ton	£90	£90	..
e " " Rod .. per ton	£84	£84	..
e " " H. C. wire per lb.	9½d.	9½d.	..
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	8/- to 8/6	8/- to 8/6	..
h India-rubber, Para fine .. per lb.	4/ to 4/1	4/- to 4/1	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	63/6	67/6	6d. inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	70/- to 72/6	70/- to 72/6	..
i " Wire galvanised No. 8 .. per ton	£18 5	£18 5	..
g Lead, English Ingot .. .. per ton	£17 10 to £17 12 6	£17 12 6 to £17 15	2/6 inc.
g " " Sheet .. .. per ton	£18 15	£18 15	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£9 10	£9 10	..
d Mica (in original cases), small per lb.	8d. to 9d.	8d. to 9d.	..
d " " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large per lb.	3/8 to 7/8	3/8 to 7/8	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/3	From 1/3	..
o Platinum .. .. per oz.	£3 13 6	£3 13 6	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£144 to £145	£143 to £145	inc.
g " foil .. .. per lb.	1/9	1/9	..
n " wire Nos. 1 to 16 .. .. per lb.	1/9	1/9	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	8½d.	8½d.	..
j " Best Flax, 6 lea. .. per lb.	6d.	6d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	4½d.	4½d.	..
j " " Russian, 10 lbs. per lb.	5½d.	5½d.	..
j " Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£24 5 nett.	£24 5 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons.
e Messrs. Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

THE MUNICIPAL ELECTRICAL ASSOCIATION, 1900.

THE DISTRIBUTION OF ELECTRICITY.

By Mr. G. Wilkinson.

(Friday, June 22nd, Abstract.)

If the responsibility of an electrical engineer ceased at the bus bars in the works, his lot in life would be a happier one than it is at present; given good design of plant, sufficient boiler, engine and dynamo power, average care and intelligent supervision at the generating station, a steady electrical pressure and a constant supply of current are assured.

It is undoubtedly in the distribution of electrical energy from the generating station to the consumers' premises that the greatest risks of failure of supply occur. Here failures of a more or less serious nature are liable to occur at any moment, often without the slightest warning, occurring at widely varying periods of time, usually during wet and unfavourable weather, and possibly at a time of night or early morning when it is desirable to be in bed, or at any rate free from the cares and worries of business.

So far as experience has hitherto shown there is no difficulty in obtaining a variety of types of reliable cables; there are at least half a dozen good makers in this country, and there are as many systems of laying mains to select from, while the types and varieties of joints, joint boxes and accessories thereto in use are far too numerous.

With triple concentric distributors, it is necessary at every other service connection to cut through the outer and middle conductors to make joints on the inner and outer conductors, the alternate joints being made to the outer and middle, leaving the inner conductor intact; in many triple service joint boxes, it is necessary to cut all three conductors at every joint, and this constant cutting and the frequent insertion of mechanical junctions, doubtless tends to impair the conductivity of the main.

In some towns to avoid cutting the middle conductor the triple concentric distributors have been divided up into sections, each section being connected by a junction box which changes the polarity of the inner and middle conductors, so that the middle will be + on one section, and − in the next; all joints are made upon the middle and outer conductors only, while the balance of load is thus kept approximately equal on the two sides of the neutral or outer conductor.

Probably the advent of higher voltage lamps, and the consequent raising of the electrical pressure upon the distributors, will lead to simple concentric mains entirely superseding both the three core and triple mains for alternating current distribution purposes. For high tension distribution, concentric mains have demonstrated their superiority over side-by-side cables, both in point of efficiency and safety.

For high tension currents it is difficult to conceive a safer method of distribution, than by concentric mains with the outer conductor earthed at the station, and the writer has known numerous instances where 2,000-volt mains have been sawn asunder by careless jointers with the current on, always with disastrous result to the saw, but with no inconvenience to the jointer beyond a blinding flash when the saw has reached the inner conductor.

Owing to the almost numberless designs of boxes used in the country and the consequent limited demand for each pattern, the cost of joint boxes must necessarily remain high, and in the writer's opinion it is time an effort was made to secure standard types of joint boxes and connections for all classes of cables, which shall be recognised as most suitable and reliable for the particular purpose for which they are designed. Until there is more uniformity of design and standardisation in joint boxes, disconnecting boxes, house service boxes, terminal boxes and their accessories, the cost of connecting consumers' premises to the supply must remain high, and we cannot hope to be free from interruptions of supply, which, though, happily, in most cases occurring only at long intervals, constitute a continual source of anxiety to the engineer, and in the past have served to confirm a general impression in the mind of the public that electricity supply is unreliable, and should not be entirely depended upon either as a source of power or illumination.

In joint boxes for concentric cables the prevalent method of clamping up the outer conductors upon the insulation of the inner conductors should be condemned, as no permanently good connection can be made upon a more or less soft and elastic substance forming the insulation.

The unsatisfactory makeshift of slipping a split ferrule in between the outer conductors and the inner insulation should also be abandoned, as seldom is a sound metallic contact upon all and every outer strand of the outer conductor secured by this method; the outer conductors often being hard bound in one diameter and loose in the diameter at right angles, thus, in course of time, when the main becomes loaded to its full working density, heating is likely to take place at these contacts, the joint becoming impaired and the resistance of the main increased.

In every case the "outers" of concentric or triple concentric mains should be bent out at right angles radiating from the centre of the cable and be securely clamped between two discs of metal, which also form the necessary connections in the joint; by this means a good contact is maintained between each and every strand of the outer conductor.

If these discs of metal are made whole the centre conductor requires to be cut in order to get the discs into position, which is not good practice, although often resorted to.

To avoid this, the discs should be made in halves, the division line of the front disc being set at right angles to that of the back disc, thus securing rigidity and good conductivity when fixed. For the same reason all joint boxes for mains should be made in halves, *i.e.*, divided horizontally in the plane of the cable, otherwise the mains have to be cut to get the joint boxes on, which is a common, though bad, method.

The writer wishes to enter a protest against the far too lavish use of compound in joint boxes. Waterproof bituminous insulating compound is a very useful and necessary article to the jointer, but it is a mistake to run up a mechanical joint box solid with this substance; the connections within the box should be enclosed in a light internal box, preferably of incombustible material, to keep the compound off the connections, and the compound should be run in solid between this internal box and the outer box. The difficulties of clearing the connections of this compound, when once they are run up solid in it, are very great; the compound is seldom brittle enough to chip out with hammer and chisel, consequently it has generally to be melted out with a blow lamp. As everybody of any experience knows, this is a very tedious process, and unless great care and judgment are exercised, the insulation of the incoming cables is damaged by the heat; such work as this has generally to be done when there is a fault on the main, and it makes it impossible to effect an expeditious repair, whereas if the compound simply formed a shell round the joint between the outer joint box and a fragile inner box, the joint could be quickly cleared, and the connections readily exposed for the necessary examination, alteration, or repairs.

The author would like to see the prevailing custom of using wood or fibre boards in joint boxes superseded by the use of earthenware or other incombustible material having satisfactory insulating qualities; combustible material in house switches, fuses, and distribution boxes, has long been superseded by the use of porcelain, and possibly the same improvement will take place in underground joint boxes when a serious effort at standardisation has been made.

COMBINED MANAGEMENT OF TRAMWAY AND LIGHTING DEPARTMENTS.

By R. C. Quin, Borough Electrical and Tramway Engineer, Blackpool.

(Thursday, June 21st, Abstract.)

It will be admitted by all members of the Association that the municipal authority should be the lighting and tramway authority also. It does not follow that, because both undertakings are owned by the municipality, it is necessarily the best policy to combine generating stations. In the majority of cases this question can readily be settled; but in some, the tramway area and lighting area are far from coinciding, and it may then be advisable to have separate generating stations.

Assuming then that in our hypothetical town separate generating stations are established for lighting and tramway purposes—is it advisable to combine the two undertakings?

In both cases we must have an engineer fully conversant with the problems of economical generation and distribution of electricity, and one who fully realises the importance of continuity of supply. Whatever tramway engineers may say to the contrary, continuity of supply is of much greater importance with electric lighting than with tramways. Who then best realises that continuity of supply should be the first aim?—The Lighting Engineer. A general supply of electricity is not established for lighting only but for the supply of power also, and what "lighting engineer" is not familiar with motors? What new problems does traction supply call into existence? The question of load factor certainly arises in the calculation of sizes of cables, also the various stresses in connection with overhead line and posts will have to be provided for, and the starting, uniform running, and stopping of the tramcars be ensured by suitable arrangements. But every one of these problems is simple, and any engineer worthy of the name could readily solve them. From this it will be seen that, in the author's opinion, the man best qualified to design and work a traction system is the qualified central station engineer.

The next phase of the question to be considered is how far the engineering side of the question is dominant in a tramway supply. In the maintenance of the traction system there are several points to be considered:—

1. The maintenance of generating machinery.
2. The maintenance of cables.
3. The maintenance of overhead line and posts.
4. The maintenance of track.
5. The maintenance of cars and motors.
6. The cleansing of cars.
7. The regulation of traffic.
8. The collection of fares.

The first five are entirely engineering. The remaining three, though important, do not require that technical skill and training, nor the exercise of such resource as do the former. Suppose, then, that we appoint, as chief of our tramway department, one who has previously been manager of a horse or other tramway system. How far is he capable of efficiently controlling and maintaining the system? He is certainly competent to give due regard to the last three points (6 to 8); he might also have had sufficient experience to enable him to maintain the track. But his electrical knowledge would probably be extremely slight, and it would be then necessary to have an electrical engineer who would become the servant of the tramway manager. We shall find ourselves in this dilemma, that we have placed the maintenance and responsibility for good work-

ing of the most important part of our system upon a servant, and placed over him a man incapable, by reason of his want of knowledge, of properly controlling him.

But it may be said that the collection of fares and regulation of traffic require experience which the electrical engineer may not have. Granted that it may be so; these duties could be placed upon a traffic manager. To the author there appears no difficulty whatever, and he speaks from experience, in thus separating a tramway system, though there are advantages obtainable by placing the whole system under one responsible head.

What the author would most wish to impress upon his readers is the fact that the design and working of an electric traction system is almost entirely an engineering problem, and that the man best qualified to carry out this work is the competent central station engineer.

Discussion.

Mr. J. F. C. Snell (Sunderland), who opened the discussion, stated that in Sunderland the two departments were combined under one chief electrical engineer, to whom the manager was subordinate. The engineer-in-chief had an assistant, who took charge of the car sheds and the repair and maintenance of the rolling stock. The traffic manager controlled the cars as soon as they left the sheds.

Alderman Pearson (Bristol) lamented that the Bristol Corporation had rejected the opportunity of acquiring the tramway system, and said that in his opinion there must be a scientific management apart from the commercial management, but only one committee.

Mr. Philip Dawson (London) also spoke strongly in favour of the single control, to avoid friction, and agreed that the Corporation engineer was the man best qualified to design, carry out, and superintend the tramway installation.

Mr. Fedden (Sheffield) preferred a single supreme authority, and thought that in any case there should be a chief engineer, who would also be general manager. It was impossible to place a technical man under a non-technical man.

Bailie Willocks (Glasgow) outlined the history of the question in Glasgow, where it was decided to retain both committees. Referring to the great success of the Glasgow electric tramways, he expressed regret that not all the main engines were to be built in this country.

Alderman Woodhead (Halifax) was in favour of supplying both lighting and traction from one centre, and adduced the success attained at Halifax on this plan. Here the electrical engineer is in charge of all electrical matters, the tramway manager looks after the traffic and the rolling stock so long as it is in good order. There are two committees, which work together in harmony.

Mr. Bishop (Wigan) said that in his town there was only one committee, and the two undertakings were combined throughout.

Mr. Vesey Brown (Lincoln) considered that in large towns there should be separate works, but in small ones they should be combined.

Mr. Quin, in his reply, upheld the principle that the electrical engineer should be chief of the department, but remarked that it would be bad policy to lower the manager of a previously existing system; he had no difficulty in getting on with his traffic manager, nor did he see why there should be any.

COPPER SAVING IN THE JOINT TRANSMISSION OF DIRECT AND ALTERNATING CURRENTS.*

By FREDERICK BEDELL.

If a source of direct electromotive force of 50 volts be connected in series with an alternating electromotive force of 50 volts, the total electromotive force as measured by a voltmeter will be found to be approximately 70 volts. This may be very easily tried. What is true of electromotive forces is likewise true of combined direct and alternating currents, and this, too, may be shown by experiment, but not so easily. It may be shown on the draughting board by plotting the alternating current, displacing its axis by an amount equal to the direct current, and ascertaining the virtual value of the resultant by means of a planimeter from a curve plotted to show the squares of the resultant current. Plotted with polar co-ordinates the process is simpler. The result is always the same.

If different values be given to the direct and alternating current, the resultant will always be greater than either, but less than the algebraic sum; in fact, *the resultant will be found to be the hypothenuse of a triangle, whose two sides are respectively equal to the direct and alternating currents*, virtual values being used in all cases.

That this is generally true may be proved as follows:—Let A $\sin x$ be the alternating current, with maximum value A and virtual value $A = A \div \sqrt{2}$. Let B be the value of the direct current. The resultant instantaneous value of the two combined is

$$y = A \sin x + B.$$

The mean square value of y is $\frac{1}{\pi}\int_0^{\pi} y^2\,dx$,

or $\frac{1}{\pi}\int_0^{\pi} B^2\,dx + \frac{1}{\pi}\int_0^{\pi} 2AB \sin x\,dx + \frac{1}{\pi}\int_0^{\pi} A^2 \sin^2 x\,dx.$

Integrated between the limits 0 and π, the first term becomes B^2 and the second term vanishes. The third term* becomes $\frac{A^2}{2}$ or A^2.

The mean square value of the resultant y is accordingly $A^2 + B^2$. The virtual value is equal to the square root of the mean square values, or $\sqrt{A^2 + B^2}$. Hence: *If an alternating and a direct current be superposed, the virtual value of the resultant is the square root of the sum of the squares of the direct and alternating currents.*

This result may be shown to be true, irrespective of the wave form of the alternating current.

From the foregoing, it follows that the joint transmission of direct and alternating currents results in a saving in weight of copper and in copper losses, and it will be shown in the tables which follow that *either saving may be as much as 50 per cent.*

Table I.

Relative heating effects of like and unlike currents.

i, first current.	i, second current.	$1 + i$, sum.	$1'$ resultant, unlike currents.	Heating effect like currents.	Heating effect, unlike currents.
1	·1	1·1	1·005	1·21	1·01
1	·2	1·2	1·020	1·44	1·04
1	·3	1·3	1·044	1·69	1·09
1	·4	1·4	1·079	1·96	1·16
1	·5	1·5	1·118	2·25	1·25
1	·6	1·6	1·166	2·56	1·36
1	·7	1·7	1·221	2·89	1·49
1	·8	1·8	1·281	3·24	1·64
1	·9	1·9	1·345	3·61	1·81
1	1·0	2·0	1·414	4·00	2·00

It is not my purpose here to consider the question of systems of distribution for the joint transmission of direct and alternating currents, except in the one aspect of copper saving. It may be said that no engineering obstacles arise to detract from the practicability and desirability of such a system. The requirement is a system of line distribution, whereby independent A.C. and D.C. generators may supply current to independent A.C. and D.C. apparatus, the alternating and direct currents being independent in their generation and utilisation, and combined in their transmission.

In the following discussion, let us designate the two currents as 1 and i, these being called the first current and second current respectively. When each current is transmitted by an independent conductor, we will designate, by R and r, the resistances of the

Table II.

Showing the saving in distributing direct and alternating currents jointly instead of separately, on the basis of constant current density

1, first current.	i, second current.	Saving in total copper per cent.	Saving in total line losses, per cent.	Saving in drop for 1, per cent.	Saving in drop for i, per cent.
1	·1	8·64	8·64	·50	90·05
1	·2	15·00	15·00	1·96	80·40
1	·3	19·69	19·69	4·21	71·27
1	·4	23·07	23·07	7·15	62·86
1	·5	25·47	25·47	10·55	55·27
1	·6	27·12	27·12	14·24	48·54
1	·7	28·18	28·18	18·10	42·67
1	·8	28·83	28·83	21·94	37·55
1	·9	29·21	29·21	25·65	33·09
1	1·0	29·30	29·30	29·30	29·30

conductors for the currents, 1 and i, respectively. For the first current the line losses are R 1^2 and the drop R 1; for the second, the losses are $r\,i^2$ and the drop $r\,i$; in the separate systems the currents 1 and i are supposed to be transmitted at the same current density. When the two currents are transmitted jointly over the same conductor, let $1'$ be the virtual value of the resultant current, and R′ the resistance of the common conductor. For convenience, the first current, 1, is the larger and is taken as unity. The resistance, R, is likewise taken as the unit of resistance. A single length of conductor is taken as the basis of discussion. Table I. shows the relative heating effects of like and unlike currents. Table II. shows the saving in the joint transmission of direct and alternating

*Read at the New York meeting of the American Association for the Advancement of Science, June 26th to 30th, 1900.

We are indebted to the courtesy of Mr. Bedell for an advance proof of this paper.—Eds. Elec. Rev.

* $\sin^2 x = \frac{1}{2} - \frac{\cos 2x}{2}$.

Hence, $\int_0^{\pi} \sin^2 x\,dx = \left[\frac{x}{2} - \frac{\sin 2x}{4}\right]_0^{\pi} = \frac{\pi}{2}$.

currents on the basis of the same current density in their joint transmission as in their independent transmission. Table III. shows the saving in the copper when the total losses are the same for joint as for independent transmission. Table IV. shows saving in losses for same amount of copper. Table V. is on the basis of discarding entirely the copper of one of two systems and retaining only the copper of the remaining system to carry both currents. I am indebted to Mr. William Ambler for assisting in computing and checking the tables.

Discussion of Table I.—The fourth column in this table gives the virtual value of the resultant current I' obtained from the joint transmission of the currents I and i, either one of these being alternating and the other direct. It will be seen that the resultant

Table III.

Showing saving in copper and change in line drop, for joint transmission, with the same total losses as in separate transmission.

I, first current.	i, second current.	Saving in total copper per cent.	Increase in drop for i, per cent.	Saving in drop for i, per cent.
1	·1	16·5	9·0	89·1
1	·2	27·8	15·4	76·9
1	·3	35·4	19·2	64·2
1	·4	40·9	20·7	51·7
1	·5	44·3	20·0	40·0
1	·6	46·9	17·6	29·4
1	·7	48·4	14·1	20·1
1	·8	49·3	9·8	12·2
1	·9	49·9	5·0	5·6
1	1·0	50·0	0·0	0·0

current is always considerably less than the algebraic sum of the two component currents, and that, in fact, it is only slightly larger than the value of the first current. (Column 1.)

This saving in the resultant current assumes importance from the fact that the line losses vary as the square of the current. If the two currents I and i were like currents the losses would depend upon the *square of their sum*. When one current is alternating and the other direct the losses depend upon the *sum of their squares*. For like currents, I and i, flowing through a resistance R, the losses are—

$$R I^2 + 2 R i I + R i^2.$$

For unlike currents, the losses are only

$$R I^2 + R i^2.$$

These are tabulated in the last two columns of Table I., from a comparison of which the saving, in using unlike currents, is obvious. For example, let us suppose we have a line carrying one ampere of current. If we increase this by the addition of one ampere of like current, the losses will be four; whereas if we add one ampere of

Table IV.

Saving in changing from separate to joint transmission on the basis of the same amount of total copper:—

I, first current.	i, second current.	Saving in total loss, per cent.	Saving in drop for i, per cent.	Saving in drop for i, per cent.
1	·1	16·5	9·1	90·9
1	·2	27·8	16·7	83·3
1	·3	35·4	23·1	76·9
1	·4	40·9	28·6	71·4
1	·5	44·3	33·3	66·7
1	·6	46·9	37·5	62·5
1	·7	48·4	41·2	58·8
1	·8	49·3	44·4	55·5
1	·9	49·9	47·4	52·6
1	1·0	50·0	50·0	50·0

unlike current, the losses will be only two. Now, every current of two amperes may be considered as made up of two like currents of one ampere each. If one of these could be replaced by an unlike current, the losses would be reduced in the ratio of 4 : 2. As has been shown above, when we combine an alternating and a direct current the losses are $R I^2 + R i^2$; that is, the losses are the sum of what the losses would be separately. *This means that each current acts as though it had the whole conductor to itself and the other current were absent.* Accordingly the conductors of an alternating current system may be used also as the conductors for a direct current, exactly as if the alternating current did not exist, and *vice versa*. The losses are figured independently, being $R I^2$ and $R i^2$. Inasmuch as line losses and line drop are proportional, *we may figure the line drop for the alternating current as though the direct current did not exist, and figure the drop for the direct current as though the alternating current did not exist.*

The line drops for the two currents are R I and R i.

Why Unlike Currents do not Interfere.—That two unlike currents in no wise interfere may, perhaps, be appreciated from the following example:—Suppose we have a direct current of 10 amperes and add thereto an additional ampere of like (direct) current. The whole current is now 11 amperes, which flows with uniform density in the conductor, so that the original current of 10 amperes has only $\frac{10}{11}$ths of the conductor for its use. An additional current of like kind, therefore, interferes with the original current. Let us now suppose that with an original direct current of 10 amperes we have an added

Table V.

Showing the saving when of two systems carrying currents I and i, at the same current density, the latter system is abandoned and the former system (unchanged) carries both currents.

I, first current.	i, second current.	First (I) system.	Second (i) system copper saved, per cent.	Second (i) system saving in line losses and drop, per cent.	Saving in total losses, per cent.	Saving in total copper, per cent.
1	·1	Nothing altered. Line drop and losses, weight of copper as before.	100 per cent. saved.	90	8·27	9·1
1	·2			80	13·30	16·7
1	·3			70	16·16	23·1
1	·4			60	17·15	28·6
1	·5			50	16·67	33·3
1	·6			40	15·03	37·5
1	·7			30	12·30	41·2
1	·8			20	8·83	44·4
1	·9			10	4·80	47·4
1	1·0			0	0·0	50·0

ampere of alternating current. Half the time this is of the same polarity as the direct current, increasing the current density in the conductor, but half the time the alternating current is opposite in polarity to the direct current, and during this time makes the total flow of current less and the current density less than for the direct current alone. In other words, *the additional ampere of direct current interferes all the time with the original direct current; whereas the additional ampere of alternating current acts as a detriment for half the time, and as an assistance for half the time, and these two effects cancel.*

Discussion of Tables II., III., IV., and V.—These tables show the saving in joint over separate transmissions under different conditions. On the basis of a given current density, Table II., there is a saving both in copper and in losses, which may amount to 29 per cent. in each simultaneously. In Table III. the saving is in copper alone, and in Table IV. in losses alone, running up to 50 per cent. in each case. Table V. shows the saving under very practical conditions, that is, one system is in nowise changed. This is the case where we already have an existing system installed and superpose a second current.

In designing a new composite system, a good rule to follow is to figure the conductors first for each system independently, and instal the larger conductor only. The saving will then be as in Table V. Nothing is sacrificed, and there is a decided gain.

Extension of Profitable Radius of Distribution.—Inasmuch as direct current can be transmitted on the whole more economically jointly with alternating current than separately, it follows that the radius of economic transmission of direct currents can be thus extended. We may draw a circle inside of which it is already profitable to transmit direct current by the usual independent system In this circle, the advantage obtained from the joint transmission of direct and alternating currents comes from the greater profit on account of the saving already pointed out.

We may draw a second larger circle within which it is profitable to transmit alternating and direct currents jointly for general purposes. Outside the first circle and within the second, the advantage in the joint transmission arises from the extension of the profitable territory covered. It is not possible to lay down any general rule for determining the size of these two circles, local conditions being controlling elements.

Beyond the second circle it is not profitable to transmit direct current, even in conjunction with alternating for general purposes. However, direct current may then be transmitted to advantage over alternating lines for special purposes, among the most important of which may be placed the starting of rotary converters, supplying magnetising current for synchronous motors, and the like. For these special purposes the gain is not so much in the efficiency as it is in the increased engineering possibilities, the discussion of which is beyond the scope of this paper.

APPENDIX.

Method of Computing Tables.

Table I.—Resultant current $I' = \sqrt{I^2 + i^2}$. Fifth column is $(1 + i)^2$; sixth column, $I^2 + i^2$.

Table II.—If the copper is worked to the same current density, the saving in total copper is equal to the saving in total current. The total current is decreased from $1 + i$ to $I' = \sqrt{1 + i^2}$. The saving is $1 - \frac{I'}{1 + i}$.

The saving in line losses, fourth column, is the same as the saving in copper on the basis of constant current density.

The line drop for I and i varies directly with the line resistance.

For constant current density, $R = 1$, $r = \frac{1}{i}$, and $R' = \frac{1}{I'}$.

For I the saving in drop is $1 - \frac{R'}{R} = 1 - \frac{1}{I'}$.

For i the saving in drop is $1 - \frac{R'}{r} = 1 - \frac{i}{I'}$.

Table III.—Equating the total losses for the joint and separate transmission—

$$R I^2 + r i^2 = R' I^2 + R' i^2$$
$$1 + i = R' (1 + i^2)$$
$$R' = \frac{1 + i}{1 + i^2}$$

Here we have substituted $R = 1$, $I = 1$, $r = \frac{1}{i}$ (for the same current density in the two separate systems). In the joint distribution the weight of copper is proportional to $1 + R'$; in the separate distribution, to $\frac{1}{R} + \frac{1}{r} = 1 + i$. Hence the saving is

$$1 - \frac{1 + i^2}{(1 + i)^2} = \frac{2i}{(1 + i)^2}.$$

For I the saving in drop is

$$1 - \frac{R'}{R} = 1 - \frac{1 + i}{1 + i^2}.$$

This is always negative, showing an increase in drop.

For i the saving in drop is

$$1 - \frac{R'}{r} = 1 - i\,\frac{1 + i}{1 + i^2}.$$

Table IV.—For separate transmission the losses are $R I^2 + r i^2$. Putting $R = 1$, $I = 1$, $r = \frac{1}{i}$ (for the same current density in the two separate systems) the line losses become $1 + i$. In the joint transmission the losses are

$$R' I' = \frac{1}{1 + i}\,(1 + i^2).$$

This is obtained by substituting

$$R' = \frac{1}{\frac{1}{R} + \frac{1}{r}} = \frac{1}{1 + i}\text{; and } I' = 1 + i^2.$$

The saving is accordingly $1 - \frac{1 + i^2}{(1 + i)^2}$.

The saving in drop for current I is proportional to the change from $R = 1$ to $R' = \frac{1}{1 + i}$. This saving is $1 - \frac{1}{1 + i}$.

For i, the resistance changes from $r = \frac{1}{i}$ to R'. The saving is $1 - \frac{i}{1 + i}$.

Table V.—The saving in copper, so far as the second system is concerned, is 100 per cent, inasmuch as it is entirely displaced. The line losses and drop for the second system are diminished in proportion to change in resistance from r to R'. The saving is $1 - \frac{R'}{r} = 1 - i$. Here $R' = R = 1$, and $r = \frac{1}{i}$ for the same current density in the two independent systems.

The total copper is now proportional to 1 instead of $1 + i$, the saving being $1 - \frac{1}{1 + i}$.

Separately, the losses are $R I^2 + r i^2 = 1 + i$. Jointly, the losses are $R I^2 + R i^2 = 1 + i^2$. The saving is $1 - \frac{1 + i^2}{1 + i}$.

SOME GENERAL CONDITIONS GOVERNING POWER STATION DESIGN.*

By PHILIP DAWSON (Member of the Council).

I must apologise for the incompleteness of this paper. I was only informed late on Saturday night that I should have to read it this evening, and only had a short time this morning in which to write it; as all my data were in my office, I was unable to start on it till this morning, having many other things to do besides.

At the present moment, when electric traction is making such rapid strides, the question of the source of supply of power is a very important one. In this paper it is proposed to briefly consider this question from the economical point of view. This is the most important one, and the engineer's knowledge and experience should be used to design and construct the source of supply of electrical energy in such a manner as to furnish the Board of Trade unit at the switchboard at the lowest possible cost, interest on capital, depreciation and sinking fund included. It may be argued that the cost of the unit at the switchboard being low, it does not necessarily follow that the cost of the power, say, per car or per train mile, will also be low, as it is possible that in order to secure cheap current, the power station may be so located as to cause great expense in feeders, sub-stations, and loss in the transmission.

In the numerous cases, both in Great Britain, on the Continent, and in America, which have come under my notice, I have never found this to be the case. This applies to power supply stations intended for traction and power primarily, and lighting secondarily. It may be mentioned at once that the demand of current for both traction and power transmission purposes is increasing so rapidly, that lighting will shortly in any case be only a secondary consideration.

The combination of a lighting and traction station is not to be recommended, and good results cannot be expected. The case is, however, entirely different where traction and lighting are combined, and the best results are then obtainable, that is to say, where the station has been designed by experienced traction engineers for traction and lighting.

It may be of interest to consider what are the differences between a station designed for lighting and one designed for traction and power transmission.

The average number of hours per annum during which a lighting station will be running full load will probably never be equivalent to more than three months' continuous running per annum, that is to say, taking the total Board of Trade units generated in one year, and seeing how long the plant under consideration would have to run its full capacity continuously to generate this amount, this time would probably never exceed three months. Taking a representative traction station, the time of continuous running would probably be at least 9, and in some cases 10, and even 11 months.

A lighting plant must in three months earn enough money to pay working expenses and to pay interest and allow for depreciation and sinking fund for a whole year, whereas a traction plant has from 9 to 11 months to do the same thing.

A lighting plant is on an average practically at a standstill 18 hours a day, while a traction plant is running 18 to 20 hours a day. Economical boilers, engines and electrical generating and transmission devices are therefore far more important in a traction than a lighting plant, because it is well known that running at very light loads and keeping the fires banked and the boilers, steam pipes, engines, &c., hot uses very nearly as much fuel as running them at full load.

Furthermore, whereas in a lighting plant there is ample time to overhaul the plant and execute necessary repairs, the men during the day have little or nothing to do and can well do this work. In a traction plant there is little or no time to do this. The conditions are quite, if not more, arduous than on a ship. There at least every few days or few weeks the whole plant is entirely shut down for several days and can be taken to pieces and overhauled.

Unexpected and rapid overloads must be able to be supported by the traction plant which is not generally the case in lighting.

In a traction station it will be seen that a far greater figure is cut by the cost of generation, pure and simple, than in a lighting station, and that the question of interest on capital expenditure and sinking fund is relatively smaller in the former than in the latter.

The following figures, which are the result of actual experience, may be of interest, and show the influence of continuous running on the cost of production:—

	Cost in pence per Board of Trade unit. Lighting.	Traction.
Fuel	0·03 to 2·2d.	0·09 to 0·5d.
Oil, waste and stores	0·05 „ 0·38d.	0·005 „ 0·2d.
Wages and salaries	0·26 „ 1·60d.	0·03 „ 0·4d.
Maintenance ...	0·054 „ 0·6d.	0·0025 „ 0·06d.
Total	0·684 „ 4·78d.	0·1275 „ 1·16d.

The difference which exists between a plant working practically continuously and only intermittently is at once seen in the average amount of coal consumed per unit generated. The type of engine used must, however, also be taken into consideration.

Thus, taking the published results of British electric light plants, we find that the cost of coal per unit generated varies approximately between 0·3d. and 2·2d. Comparing this to traction plants, we find the cost of coal varying between 0·09d and 0·50d. per unit generated. Again, considering the item of wages and salaries in a lighting station, we have 0·3d. to 1·6d.; in the case of traction this is 0·03d. to 0·40d. per unit.

Comparing the total cost of production of one Board of Trade unit generated in a lighting station and in a traction station, interest and sinking fund excluded, in the former the unit varies 1·00d. to 4·00d., as compared to 0·25d. to 1·00d. for traction purposes. The cost of power when generated for traction and power purposes is one-quarter of that when generated for lighting only.

The amount to be added for interest and sinking fund, of course depends on the length of the concession, on the terms of final purchase, and on the life of the machinery employed. The cost of producing power varies with the amount to be produced, decreasing as the amount increases. This shows the advisability of concentrating as much power as possible in one station, and reducing the number of units.

In considering the various items which go to make a complete power or traction installation, including the system of feeders, distributors, track, and overhead line, the cost of the power station is but a comparatively small item. The saving which can be effected

* Paper read before the Tramways and Light Railways Association at the Agricultural Hall Exhibition, Monday, June 25th.

by a properly designed station is very great, and a little extra capital expenditure is in many cases well justified.

The total cost of running an electric tramway or railway varies between 2·50d. and 8·00d. per car mile, according to circumstances; the electrical energy at the power station required varying from 0·49 unit to 1·4 units per car mile, according to the profile of the line and the weight and speed of the cars.

The cost of power varies between 10 and 30 per cent. of the total working expenses, all charges included, and if it can be reduced by ¾d. to 1d. per unit, or we may say per car mile, as one unit at the switchboard is a fair estimate of the average power requisite at the switchboard per car mile run, it is well worth doing.

In the early days, before polyphase high tension currents were known, the situation of the central station was practically imposed, very little latitude being possible owing to the maximum distance of economical transmission being limited. Electricity works being most required in crowded centres, it was not only difficult to obtain a site at all, but the cost of the ground was very great. Hence the necessity of crowding the greatest amount of power into the smallest possible space. The plant being mostly used for lighting and only running a few hours each day, highly economical engines and boilers and labour-saving appliances were of but little advantage. At present circumstances have altered; electricity can be economically transmitted to any distance, and is utilised—and will be more and more so every day—firstly for power purposes, and secondly for lighting purposes.

The initial cost of a plant may be roughly divided into four parts—land and buildings; plant, including all machinery in station; mains, feeders, and distributors; miscellaneous, which includes such things as meters, instruments, cost of provisional order, and such like.

According to Mr. Emile Garcke's figures in the "Manual of Electrical Undertakings," the average cost of existing British plants expressed in percentage of total capital expenditure is approximately as follows:—

Land and buildings	19 to 23 per cent.
Machinery and plant	36 to 37 „
Various remaining items	4 to 14 „

As regards the first item the above average includes several old lighting stations, and there is little doubt that if a new plant were installed the cost of land would be materially reduced.

The question of system of generation whether in several large stations generating continuous current or in one large station generating either continuous or polyphase currents is of great moment.

As already stated previously, in a traction station much greater capital expenditure is justified, and coal-handling appliances can be installed which enable one or two men to look after the largest boiler room. Automatic lubricating system and ash conveyors, &c., enable one or two men to be sufficient in the largest engine room. It will be evident that the item wages and salaries will be far greater in several than in one station. Also the waste of coal, &c., will be far greater. From a careful study it is nearly certain that, for anything above 5,000 kw. capacity, one polyphase station operating rotary converter sub-stations is the best. Large units are also always advisable. It interests me to see that the sizes of units I recommended several years ago, are generally being adopted. For reference, it may perhaps be advisable to append this table:—

Sizes of Engines recommended for Use in Power Stations.

Maximum power required, I.H.P.	Number of engines.	Power of each engine, I.H.P.
200	2	200
400	3	200
600	3	300
1,000	3	500
1,500	4	500
2,000	4	750
5,000	6	1,000
10,000	6	2,000
20,000	6	4,000
40,000	9	5,000
60,000	11	6,000
90,000	10	10,000

All engine builders who have had experience in tramway work now make an entirely different kind of engine for traction from that which they supply for lighting stations. The conditions under which a tramway engine works are, if anything, more onerous than those of a rolling-mill engine. A slight variation, either in number of revolutions per minute, or in angular velocity per revolution, is of the greatest importance in a traction station, whereas it is of small importance in a rolling mill.

A uniform speed is especially important where compound wound dynamos are run in parallel direct on to the line. If the momentary difference in speed between two engines exceeds very narrow limits, the voltages of the machines differ, and cause very heavy currents in the equalising bars, and largely increased core losses, hence great waste. If the difference becomes too great, one of the generators may even be reversed. Where multiphase machines run in parallel, constant speed is of even greater importance to keep the machines in step. In cases where shunt wound generators with heavy batteries of accumulators run in parallel on the line, the question of engine regulation is not so important.

A traction station where compound wound dynamos are used should be so arranged that, if the normal load be suddenly thrown on or off an engine, the speed shall not vary more than 2 per cent. either way. In some cases a maximum variation of 1½ and 1¼ per cent. is all that is allowed. Where polyphase currents are used, constant speed is of even greater importance; and a guarantee should be required that under no circumstances shall the angular velocity during one revolution vary more than ½ per cent., and in some cases not more than half of 1 per cent. With heavy flywheels, and governors properly designed for tramway work, it is quite practicable to fulfil the above conditions.

Or expressed in a different way, in polyphase work the engine should not produce by variation of angular velocity a phase displacement of more than 5° per half cycle.

From careful comparison of many existing systems, it may be taken that the total cost of power, all fixed charges included, for one large station as compared to that for two or more smaller stations together equal in power to the larger one, is from 30 to 75 per cent. lower.

DIRECT CURRENT BOOSTERS.

By CLAUDE W. HILL.

A booster consists of a generator connected into a feeder circuit for the purpose of adding voltage. The feeder current passes through the armature of the generator, and a portion or the whole of it through the field windings, which are usually connected in series with the armature. The machine is driven in any convenient manner at a constant speed, usually by a shunt motor driven off the main circuit.

As the fall of pressure in the feeder is practically proportional to the current, the rise of pressure of the booster should also be proportional to the current; that is to say, it should give as nearly as possible a straight line characteristic.

A diagram of a track feeder booster with its motor is given in fig. 1, in which the main circuit voltage is from 450 to 550 volts, and the feeder current is 200 amperes with a fall of 50 volts.

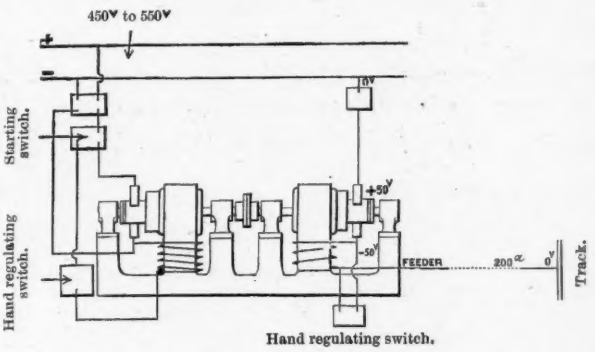


Fig. 1.

Motor.—It is necessary that the motor should run as nearly as possible at a constant speed. To accomplish this with the variation of voltage already mentioned, the magnetic circuit of the motor must be worked at a low density so that the magnetic flux will be approximately proportional to the volts across the field winding. A variation of pressure at the terminals will then be accompanied by a variation in the back E.M.F. of the machine and a more or less proportional variation in the magnetic flux, so that the speed will tend to remain constant.

Owing to the low density the armature reactions have to be carefully limited in order to avoid sparking.

The induction curve of a typical motor is given in fig. 2, and an external characteristic, in which ordinates = speed and abscisse = volts on terminals of motor, is given in fig. 3. Two curves are given in the latter figure, one for the motor unloaded and one with the full load of 200 amperes flowing in the feeder. At no load the speed with 550 volts is 1,200, and with 450 volts it is 1,120, the discrepancy being due to the induction curve departing slightly from a straight line. When fully loaded, with the brushes midway between the poles, the speed is lower, as shown on the curve, but by moving the brushes and so increasing the armature back turns the full load line can be made to almost coincide with the no load line, so that only the variation of speed due to variation of voltage remains, but for reasons to be stated later, this does not appear advisable.

Generator.—As already stated, it is desirable that the induction curve of the generator should be as nearly as possible a straight line. It is not possible to obtain a perfectly straight line, but fig. 2, which applies to the generator as well as the motor, is near enough for practical purposes.

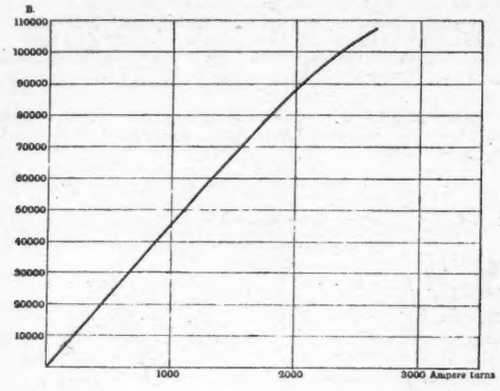


Fig. 2.

The generator being series wound, the question of sparking is not so difficult to deal with as in the motor, as increase of current carries with it increase of gap excitation, so that a considerable overload can be carried without trouble from sparking.

If the rise of E.M.F. of the generator were exactly proportional to the current, the volts across the feeder would be almost zero with all currents, the only discrepancy being that due to want of constancy in the speed of the motor. It is

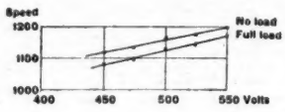


Fig. 3.

not possible to get such close regulation as this, but by adjusting the machines so as to give zero potential across the feeder with 500 volts on the motor and 150 amperes in the feeder (on the assumption that these would be the average figures) we get the curves, fig. 4, in which ordinates = volts + or − across the feeder and abscissæ =

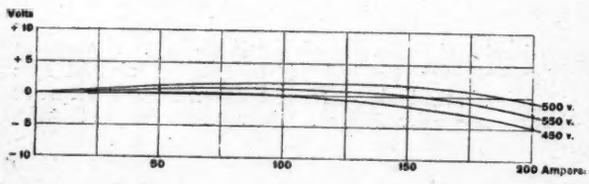


Fig. 4.

amperes in the feeder. To obtain closer regulation than this the hand regulating resistances would have to be used.

Fly-wheel Action.—As has been already remarked, the generator magnets having a low density and being series wound, the gap excitation increases with the current, so that a large overload will not cause deleterious sparking.

With the motor this is not the case, as the excitation is practically constant, irrespective of the current in the armature, so that it is desirable to avoid the excessive currents due to the fluctuating overloads on the generator. To do this we may utilise the momentum of the armatures by allowing a difference of speed between no load and full load and by adding a fly-wheel if found necessary.

An excessive current could not then flow in the armature of the motor unless the speed were retarded, and the retardation would be resisted by the fly-wheel action.

It is a matter for trial in any particular case as to whether the difference in speed need be so much as shown in fig. 3. If a trial shows it to be more than is necessary, it may be diminished by adjusting the position of the brushes.

ELECTRIC TRAMWAY EXHIBITION.

(*Concluded from page* 1119, *Vol.* 46.)

The short length of line at the Agricultural Hall worked on the Westinghouse sectional conduit system is shown in one of the photographs which we illustrate this week. To the left in the picture are seen motors and trucks, which also formed part of the British Westinghouse Company's exhibit. As to the braking equipment of the car, it may be of interest to describe briefly the Newell electro-magnetic brake. It consists of a horse-shoe electro-magnet, suspended on spiral springs, so that the legs hang directly above the rail. When this magnet is excited it grips the rail, as does the shoe of an ordinary track brake. There is an important difference, however, between the effects of the Newell brake and those of the ordinary type of track brake, when applied. In the case of the latter the braking effect is gained at the expense of the car weight, that is, by reducing the grip of the car wheels on the rails, and therefore destroying to a considerable extent the effect of the wheel-rim hand brake. In the Newell brake, by a simple arrangement of levers connecting the electro-magnet with the shoes of the wheel-rim hand brake, the pressure of the shoes on the track is taken up by an increased thrust or pressure on the shoes of the wheel-rim hand brake. Thus an increasing braking effect on the wheel rims is caused, and the effective weight of the car on its wheels is not changed by the application of the track brake. Another point is that the power for the brake is produced by the generator current of the car motors; the electro-magnet is not excited by current taken from the mains. The momentum of the car, after the main current to the motors has been switched off, drives the motors as generators, and it is this current from the motors which furnishes the power for the electro-magnetic brake. The action of the brake, therefore, is independent of the continuity of the main electrical supply, and any failure of the supply current would not interfere with the braking of the cars. There is thus a triple-braking action with the Newell brake, the loading of the motors as generators, the grip of the magnet shoes on the track, and the increased pressure on the wheel-rim shoes. The proportion of the braking effects on any car produced in the last two cases is adjusted to the weight of the car and the gradients of the track, so that the maximum pressure which will not cause skidding of the wheels may be applied to the shoes of the rim brakes. In the case of the Exhibition car, which weighs 12 tons, empty, the thrust on the rails is equal to that on the wheels, but on an 8-ton car, 60 per cent. is applied to the rails and 40 per cent. to the wheels. The brake is actuated by a backward motion of the controller handle. The car is also provided with the usual hand brake.

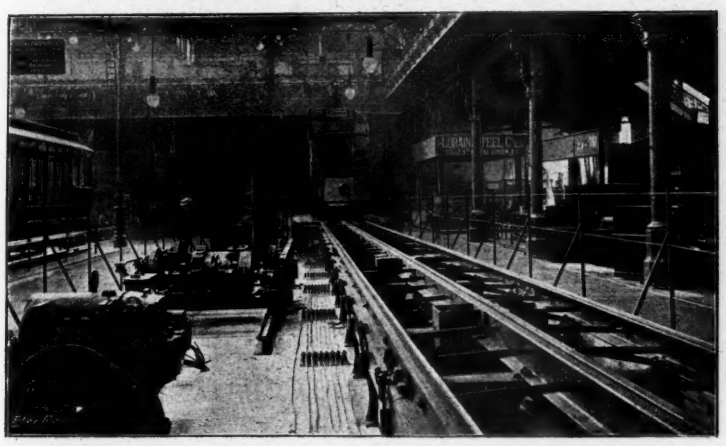
We have no desire to institute comparisons as to the importance of the various exhibits. All are important, and must serve a useful purpose to the exhibitor as well as to the visitor, but space will not permit us to describe the various apparatus in detail. A new form of plastic bond was exhibited at the stand of R. W. Blackwell and Co., Limited, who are introducing them to the English market. A series of tests was conducted on the new bonds at the Exhibition.

There are several plastic bonds, differing considerably in form, but all using the same principle, which consists of making electrical contact by means of the Edison-Brown plastic alloy. The two surfaces to be connected are cleaned from rust, scale, &c., and rubbed with a solid alloy, which silvers them and prevents rust. The space between the surface is then filled with plastic alloy, kept in position by suitable means, which adheres to the amalgamated surfaces and forms a flexible and permanent joint of very low resistance.

The latest type of plastic bond now being introduced on to the market is Harold P. Brown's plastic copper bond. It is stated to possess several great advantages by practically combining all the advantages of the various types of copper and plastic bonds without any of their disadvantages, and much is expected of it. This bond is made of a rectangular piece of rolled copper 3 inches long, the other dimensions depending on the current to be transmitted. Cup-shaped projections are pressed near each end, giving a contact against the rail web close to the ends of the rails. Each cup contains a steel spring, bearing on a steel plate to prevent it cutting into the copper. Before application the various parts are held together by a small iron strap. In the latest type of bond the whole copper portion is embedded in a square piece of specially prepared cork. Two circular holes are left in the cork into which two amalgamated spring washers fit, and which are filled with plastic alloy. By this means the bond serves the double purpose of a copper and a plastic bond. The current is conveyed to and

rom the fishplates by the plastic plugs, and also through the copper strip which is held against the web of the rail by the spring washers. A fair amount of movement at the joints does not spoil the contact of the bond, which is firmly held to the surface of the rail by the free mercury, which also serves as a lubricant, allowing if necessary the bond to slightly shift without in the least spoiling the good contact or conductivity of the joint. When bolted in position a sharp edge on the outside of the springs cuts through the strap and enters the angle plate, thus aiding the conductivity. All the parts are amalgamated to prevent rusting, and the contact parts are covered with plastic alloy. The springs are designed to give a pressure of 1,000 lbs. per square inch between bond and rail when the angle plate is bolted up, being pressed quite flat when joint is first made, but subsequently taking up any wear of the bond or slackness of the joint. Spring washers should be used under track-bolt nuts. As the cups flatten with wear, the contact area increases with the age of the bond. There are no shearing or bending stresses in the copper by reason of the sliding contacts, lubricated by the plastic alloy.

The bond is guaranteed to transmit 2,000 amperes per square inch of vertical section without heating more than the rail, and to



Westinghouse Sectional Conduit System.

exhibit practically no deterioration after two years' service, provided the rail joints are properly maintained. The following tests of this bond show the low resistance which can be obtained by its use.

Description of joint.	Ohms resistance.
1. 80-lb. T rail unbonded	·000423
2. Ditto, with Edison-Brown solid copper bond.	·000009
3. 70-lb. rail double bonded (Edison-Brown solid copper)	·000009
4. Ditto, with extra bond on top of rails ...	·0000038
5. 83-lb. rail double bonded with Cork type plastic bond 1½ inches diameter hole in cork	·0000083

In tests 2 and 4 there was no pressure between bond and rail other than that produced by the weight of the bond. The bond was simply laid on contact spots prepared on the top of rail.

As regards the life of these bonds, some which were put down in Dublin five years ago, and which have recently been taken out, are stated to show as good a contact as on the day they were put in. The plastic material has remained perfectly soft, and the amalgamated spots on the surface of the rail and on the fishplate are as bright as on the day they were amalgamated. Since Dublin, these bonds have been used very largely all over the United Kingdom, and have given great satisfaction.

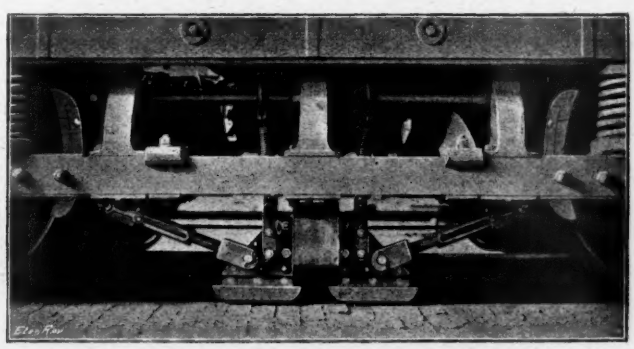
Plastic bonds have been used with great success on a great number of British and Continental lines, and when properly applied have always been found exceptionally satisfactory. By means of the plastic bond the conductivity of the joint can be made equal to that of the rail, the cost being but slightly higher than the usual copper bonding which only secures a joint having a conductivity of 1/12 to 1/6 of that of the rail. The experience in America also proves the reliability of this type of bond. On the Boston Elevated Railroad, plastic bonds put in two years ago show exactly the same low drop of pressure as when they were first put in. On the Metropolitan West Side Elevated Railway of Chicago, after three years' use, the same result was obtained, and we are informed that numberless other cases may be cited where plastic bonds have been in use for many years, and are as good to-day as the day they were put in.

As regards cost, for an equal conductivity the cost of the plastic bond, including labour of fixing, is, we understand, slightly inferior to the cost of copper bonding.

Last, but not least, the plastic bond is absolutely preserved from every corrosion or deterioration which might be caused by the chemical composition of the soil. Owing to the special method adopted in fixing these bonds, it is stated that perfect conductivity is assured even when fishplates work slightly loose.

Messrs. Blackwell's stand occupied one of the most commanding sites in the Exhibition, and showed up to great advantage. Samples of manganese steel, and specimens of the special work, frogs, switches, crossings, &c., in which it is used, were shown. Rail bonds naturally formed an interesting exhibit at this stand, where the Crown and the Edison-Brown plastic were to be seen. Various designs of trucks were shown, including the "Standard" Peckham for heavy 18 feet to 20 feet open cars; an "extra long" truck (also for long heavy cars, but where a short wheel base is required), standard gauge, 30-inch wheels, 3¾-inch axles, G.E. 52 suspensions, and fitted with adjustable life and wheel guards; a "Swing Bolster," "Maximum Traction" truck fitted with the latest pattern side frames; a short wheel base "Swing Bolster" truck, the wheels of which will radiate between the sills of an ordinary car, and successfully take curves of 30 feet radius or less. The last mentioned truck is fitted with the Price momentum friction brake. This brake consists of a friction device mounted upon the car axle to which is attached a chain which connects with the sway bar of the ordinary brake rigging. It is so constructed as to utilise the energy of the moving car for power, and it is adaptable for double and single trucks. A very complete exhibit of air brakes was shown on the adjoining stand of the Christensen Engineering Company. The "Van Dorn" coupler, the Hipwood Barrett car fender, several designs of trolleys, standards and brackets, and samples of trolley wire, insulators, were all on view at Blackwell's stand, and we must not omit to mention also "Standard" junction boxes, switches and circuit breakers, "P. and B." electrical compounds, Packard lamps, the "Trenton" trolley wagon, oil separators, steam trap, lubricators, and so on. The Conant rail tester was also shown. Its method consists of balancing the resistance of a length of rail containing the joint against that of a length of plain rail, the extra length of the latter indicating the added resistance due to the joint. A telephone in circuit with a continuous interrupter is used to show when the balance has been effected, connection being made with the rails by means of poles wired to the instrument. Three poles are used, two of them being held on the rail about 3 feet apart, so as to span the joint in question, whilst the third or indicating pole is held further down the rail, so that there is a length of plain un-

Elliott's Recording Ammeter.



The Newell Electro-Magnetic Brake.

jointed rail between it and the next pole. By means of a two-way switch, the telephone can be either put in the circuit containing the rail joint, or that containing the plain rail, the track current being used to operate the instrument. The man who holds the indicating pole carries the telephone, and moves the former about until the noise made by the interrupter is the same on either circuit. This shows the correct position of the indicating pole for balancing the

two circuits. The distances of the two outside poles from the middle one can then be measured, the difference in length indicating the resistance of the joint. The absolute resistance can be calculated if the weight of the rail is known.

In close proximity to the above exhibits were the stands of the B.T.H. Company, Brill's, Brush, and Dick, Kerr & Co., at all of which electric cars of excellent designs were on show. We rather think that many a horse-car traveller who inspects these will hail with satisfaction the prospects of London being furnished with such palatial street cars in place of what we have to put up with to-day on certain lines. The B.T.H. cars included one of those being supplied by this company to the London United Tramways Company. This is shown in the photograph below. The car body is mounted on Peckham trucks, and equipped with special "B & L" motor-rheostatic brake equipment. This car, which is one of those being supplied under contract, was exhibited by the kind permission of the directors of the London United Tramways Company. The car was constructed by Messrs. Hurst, Nelson & Co., Motherwell, to the design of Mr. J. Clifton Robinson, C.E. The other B.T.H. car is also one built by Hurst-Nelsons, and is mounted on two Brill maximum traction bogie trucks, and equipped with standard G.E. 58 double motor-rheostatic brake equipment.

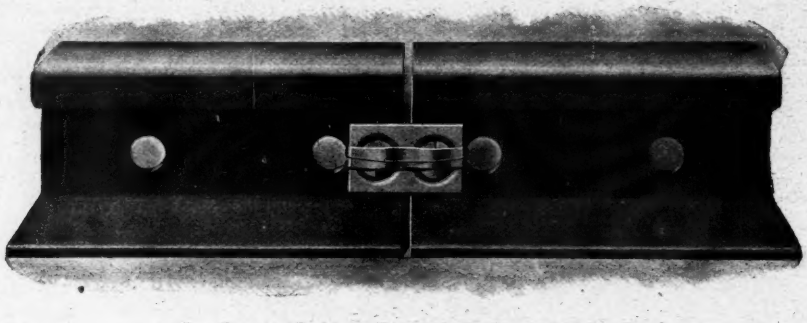
In addition to these a Hurst-Nelson truck fitted with G.E. 58 motors showed the details of the equipment. Electrical heaters, feeder pillars, B.T.H. overhead material, and a short length of conduit system with a truck with contact plow so arranged as to show the method of raising same, and illustrating the general principles of the conduit system were also in evidence at the B.T.H. stand.

Messrs. J. G. Brill Company, Philadelphia, U.S.A., exhibited the "Convertible" electric tramway car, which is the first car of this pattern shown in Great Britain. It has been built for the Leeds Corporation tramways. The chief point about it is that it provides open garden seats for passengers without their having to climb stairways to the top of the car. At the same time the car can be "closed" by the passenger at will, by simply lowering the car sides and windows, which are held in the roof of the car, and can be raised or lowered in the same manner as an ordinary window sash. This particular pattern of car has been designed and patented by Mr. John A Brill, and is the first "self-contained" car of its type ever offered to the public. The expression "self-contained" may be explained by stating that the convertible car contains all necessary parts and fixtures for making, almost instantly, either a "closed" car or an "open" car. This car has been constructed and fully tested under hard usage. Brill's exhibit also comprises full-sized and models of Brill motor trucks. The chief claims made for the Brill truck are the easy riding of the car, and also the fact that the main frame of the truck is of solid forged iron, free from bolts, nuts, or rivets.

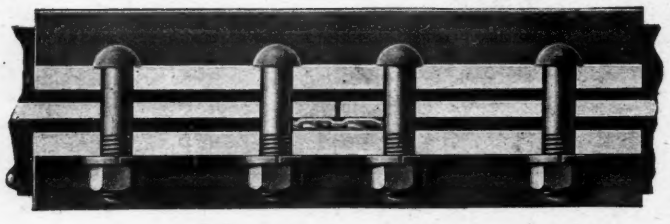
The Brush Electrical Engineering Company, Limited, exhibited a bogie vestibule car, such as they have supplied for the Swansea Improvement and Tramways Company. Divided into two compartments, with middle entrance, there is accommodation for 44 passengers. The car was mounted on bogie maximum traction trucks. Other features of the Brush exhibit were a type 1,000 A tramway motor (four polar ironclad) rated H.P. 25; a type H 2 series parallel controller, H G 2 regenerative tramway controller (Tyler's patent), and type H D 2 controller with electrical service brake.

The combined exhibit of Messrs. Dick, Kerr & Co., the English Electric Manufacturing Company, Limited, and the Electric Railway and Tramway Carriage Works, Limited, is naturally of considerable interest at the present moment. Four specimens of electric cars gave an excellent impression of the class of work which these enterprising manufacturers are now turning out. There was a bogie vestibuled top-seat car for heavy city service with Bellamy reversed stairway; a bogie cross-bench car for high speed summer suburban service; a four-wheeled top-seat car and a four-wheeled single-deck car. Motors, controllers, &c., on the Short system, a truck with motors and air brakes, also specimen permanent way work, and special track work, poles and brackets.

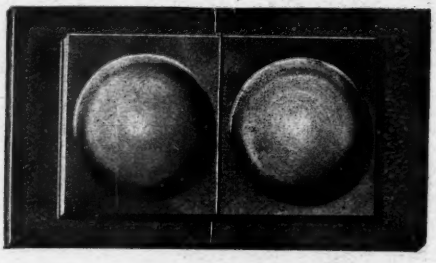
Permanent way construction material was also well represented by a good show of movable points, crossings, drain rails, join



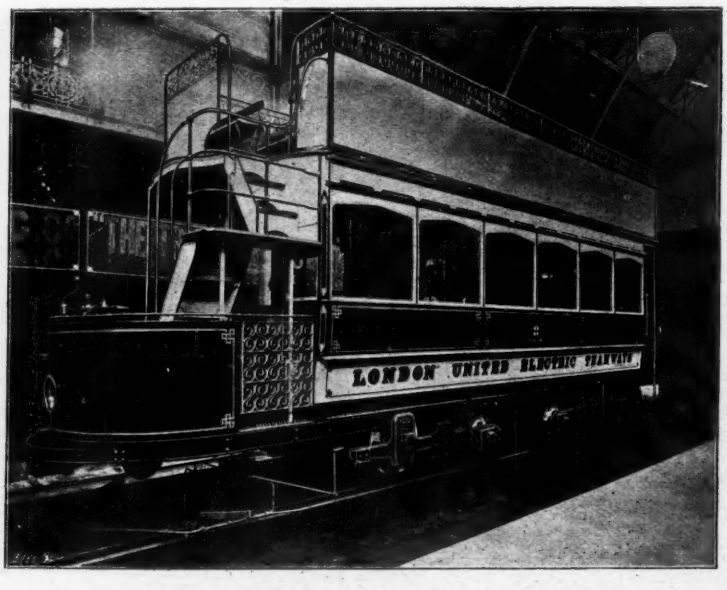
The Plastic Bond in Position ready for Angle-Plate.



Horizontal Section through centre of Bond.



Front of Plastic Copper Bond with Cork Plate.



Trolley Car for the London United Tramways.

plates, platelayers' tools, patent automatic spring points, rail carts for easy transportation of rails, Brodie's holding down arrangement for tram rails, and so on, by Messrs. Askham Bros. & Wilson, Limited.

Cables and wires were well displayed by Messrs. W. T. Glover and Co., Limited, the British Insulated Wire Company, Limited, Felten & Guilleaume (W. F. Dennis & Co.), the National Conduit and Cable Company. Overhead line work and equipment accessories were shown in detail by the Electric Tramway Equipment Company, of Birmingham, the Ohio Brass Company, of Mansfield, O., Bergtheil & Young, and Estler Bros. Among other exhibits, we must not omit to mention that accumulators as employed in connection with a large number of English electric tramways were well arranged at the stand of the Chloride Electrical Storage Company, while the Electrical Power Storage Company were also in evidence. The Meldrum Koker stoker, and the Bennis stoker, a model of a Babcock boiler, an exhibit of Caillet's monorail portable railway system by the Monorail Portable Railway Company, Limited, and one by Parry & Co. of the Ewing single-rail tramway rolling stock, which have already been described in the Electrical Review, a variety of electric heating apparatus and temperature regulating devices by the Consolidated Car Heating Company, of New York, traction poles and arc lamp-posts and fittings by the British Mannesmann Tube Company, Limited, conduits, stoneware troughs, insulators, &c., by the Doulton Company; rail-joints, special track construction trucks, and electric welded joints by the Lorain Steel Company, of Ohio; steam separators, traps, injectors, and other like accessories by Messrs. Holden and Brooke, Limited. There were also exhibits by others as follows:—Klein Engineering Company, water coolers and oil separator; Cape Asbestos Company, blue asbestos for covering boilers, steam pipes, &c.; Le Carbone, carbon brushes, primary batteries, and other electrical accessories; Anti-Friction Alloys, Limited, car bearings, &c.; William Griffiths, sections of tramway track with various pavings; S. Z. de Ferranti, Limited, rectifier and other apparatus, and numerous photographs of powerhouse electrical equipments; Simplex Steel Conduit Company, their steel conduit system; V. Demerbe et Cie, tramway track on the Demerbe system as tested and subsequently adopted at Bradford; Mr. G. F. Zimmer, models of Kreiss' and Thompson's patent coal conveyors; Frederick Nell, separators, grease extractors, jet condensers, Bennis trucks, &c.; Roller-Bearings Company, roller-bearings; Charles Churchill & Co., a large variety of high-class American machine tools. The British Griffin Chilled Iron and Steel Company, Limited (a new company recently organised for the manufacture in England of chilled iron car wheels for railways and electric tramways) show various wheels, axles, &c., made under the Griffin system. Under this process the wheel is cast in one piece so as to combine the toughness and strength of wrought-iron with the hardness on the wearing surfaces of the hardest steel. Smith, of New York, shows head lights for cars, incandescent fittings for cars, interior lighting, &c.

Messrs. Elliott Bros. had on show a Board of Trade panel, and various electrical measuring instruments of their well-known manufacture. Recording ammeters were shown to illustrate the starting currents of motors. We illustrate one of these instruments which has been recently supplied by Messrs. Elliott to a large tramway undertaking to carry current up to 6,000 amperes. The instrument is of Elliott's standard type and standard size in every way as regards the case, clock movement, paper, &c. The shunt, which is illustrated, of course is of sufficient section to deal with the current in question. This is believed to be about the largest recording instrument that has ever been constructed of this type.

Miller & Co., of Edinburgh, showed chilled car wheels, iron points, and wheel presses; J. B. Stone & Co., showed various special tools and machinery of American manufacture; Messrs. G. W. Burton, Griffiths & Co., also showed a variety of machine tools, including track drills, rail saws and other portable apparatus; Messrs. R. Becker & Co., and Messrs. Kirchner & Co., exhibited various electrically-driven tools; Mossberg Rolling Bearings, Limited, roller bearings; Helicoid Locknuts Patent (Parent) Company, Limited.

Mr. Washington Hume was displaying a working model (half size) of a patented automatic signalling apparatus worked by the locomotives, and capable of indicating to any signal box or station, the distinguishing number of any approaching train, even if late or out of its order, and also, in combination with the same, a means of signalling to the trains from the signal boxes or stations.

The Electro-Magnetic Traction Company, of Bishopsgate Street, exhibited a full size model of their closed conduit surface contact system.

The only exhibits remaining for us to mention are those of the Electric Construction Company, the Helios Company, and Witting Bros.

The Electric Construction Company exhibited a 70-kw. variable ratio transformer similar to those employed on the City and South London Railway as reducers on the E.C.C. patented arrangement in which the high tension pressure supplied is 1,000 volts, and the working conductors are at 500 volts on the three-wire system; a 30-h.p. tramcar motor was shown as a good example of what British manufacturers can do in "compactness, strength, and perfection of detail;" a Bushbury enclosed stationary motor, an E.C.C. generator, an overhead trolley for side suspension, and switchboard apparatus.

The Helios Electrical Construction Company, Limited (English agents, F. Suter & Co.), exhibited a truck, motor controller, cut-out, resistance, overhead sliding contact gear, and certain overhead material.

Messrs. Witting Bros., Limited (Electricité et Hydraulique) showed trucks equipped with two of their standard tramway motors of 30 b.h.p., controllers, resistances, and other car-handling apparatus, various tramway motors, including a 25-b.h.p. three-phase motor, and three single-phase motors of the Heyland type of ½, 2, and 6 b.h.p. respectively. Messrs. Witting also showed a 50-kw. motor-generator, three-phase transformers, and other exhibits.

We cannot close these notes without paying a tribute to the promoters of the Exhibition, the *Tramway and Railway World*, to Mr. Courtenay in particular, and Mr. Wilcox, the secretary, for the excellent way in which they have carried things through. Everyone seems to feel that the show has been fruitful of good results from the public point of view, and in some cases manufacturers have reaped an immediate return to repay them for any trouble to which they may have been put in preparing their exhibits. Certainly, to municipal authorities the Exhibition has been an enormous advantage, for by taking a journey up to London they have been enabled to see electric tramway equipments and material in such a way as they would not have been able to do otherwise without a dozen journeys in a dozen different directions to various cities where electric cars are running or where electrical factories are situated.

The numerous deputations which have come from all over the country show that they were not slow to take advantage of so excellent an opportunity of seeing what was going. Brighton, Stockport, Dover, Sheffield, Halifax, Wallasey, Blackpool, Lincoln, Glasgow, Huddersfield, Portsmouth, Leicester, the London County Council, Manchester, York, Dundee, West Ham, Birmingham, and other towns have sent their tramway committees or representatives thereof, and they have gone away with a new knowledge of electric tramway matters.

From an exhibitor's point of view, considerable interest was added to the show by the reading and discussion of papers on three nights. Mr. Philip Dawson's paper on "Some General Conditions Governing Power Station Design," we print on another page of this issue. Other papers read were by Mr. C. H. Gadsby, on "The Profits of Tramway Undertakings," Mr. John Young, of Glasgow, on "The Function of Modern Tramways," and Mr. Scotter on "The Work of the Light Railways Commission."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS, 1900.

Compiled expressly for this journal by W. P. Thompson & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

11,011. "Improvements in electrical switches for heavy currents and high potentials." H. W. Clothier. Dated June 18th.

11,020. "Improvements in or connected with electric lamps." W. M. Walters. Dated June 18th.

11,022. "An electrical apparatus for adjusting tram rail points." J. E. Macauley. Dated June 18th. (Complete.)

11,025. "Improvements in electrical apparatus for life buoys and light to facilitate the rescue of persons from drowning and for other purposes." H. Binks. Dated June 19th.

11,026. "Improvements in cord grips for electric light fittings." A. P. Lundberg and G. C. Lundberg. Dated June 18th.

11,054. "Electrically operated cloth cutting machines." N. Garland. Dated June 18th.

11,056. "Improvements in the manufacture of lead-covered cables." H. Cassirer. Dated June 18th. (Complete.)

11,097. "Improvements in electrical accumulators or secondary batteries and in the manufacture of the same." H. Woodward. Dated June 19th.

11,099. "Improvements in electric targets." J. Paterson. Dated June 19th. (Complete.)

11,101. "Improvements relating to the measurement of the magnetic properties of iron and steel." F. W. Le Tall. (M. Walker, United States.) Dated June 19th.

11,107. "Improvements in electric patterns for punching machines for embroidery machines and for Jacquard looms." E. Edwards. (C. Handwerck, Germany.) Dated June 19th. (Complete.)

11,120. "Improvement in plows for conduit electric railway cars." J. B. Gottsberger. (Date applied for under Patents, &c., Act, 1883, Sec. 103, Jan. 4th, 1900, being date of application in the United States.) Dated June 19th. (Complete.)

11,149. "Improvements in telephone switchboards." A. Whalley. Dated June 20th.

11,190. "An improvement in switches for high tension electrical currents." Siemens Bros. & Co. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated June 20th. (Complete.)

11,206. "Improvements in electric switches and like apparatus for making and breaking electric circuits." G. W. Partridge and G. K. B. Elphinstone. Dated June 20th.

11,207. "Improvements in or relating to the distribution of electricity." L. Andrews. Dated June 20th.

11,208. "Improvements in electric signalling apparatus." F. J. Warden-Stevens. Dated June 20th.

11,217. "Improvements in the method and the material for covering electric cables, conductors or wires with insulating material." G. E. Heyl-Dia. Dated June 20th.

11,218. "Improvements in telegraph transmitting devices." H. V. Gill. Dated June 20th.

11,243. "Improvements in polarised electric bells for alternating current." The British Electric Works Company, Limited, and B. Brander. Dated June 21st.

11,255. "A new or improved composition used for making electrical insulators and other articles." A. W. B. Pearson. Dated June 21st.

11,260. "Improvements in electric accumulators and in electrodes therefor." A. Tribelhorn. Dated June 21st.

11,263. "Improvements in or relating to electric lamps and fittings therefor." H. Hirst. Dated June 21st.

11,264. "Improvements in or relating to switchboards for electric distribution." H. Hirst. Dated June 21st.

11,272. "Improved means of and apparatus for preventing the premature starting of dynamos or the like used in connection with electric lifts." J. Hofbauer. Dated June 21st. (Complete.)

11,287. "Improvements in or relating to conduits for electric conductors." F. JONES. Dated June 21st.

11,308. "Umbrella tip lightning protector." P. REDFORD and J. RIDER. Dated June 22nd.

11,309. "Improved fuseboard or distributing box also applicable as a junction or connecting box." R. G. TYLER and W. E. D. DUNCAN. Dated June 22nd.

11,340. "Improvements in and connected with electric clockwork." M. FISCHER. Dated June 22nd.

11,344. "Improvements in the manufacture of filaments for incandescing electric lamps." W. L. VOELKER. Dated June 22nd.

11,358. "Improvements in or connected with secondary batteries." H. U. WOLLASTON and T. V. SHERRIN. Dated June 22nd.

11,361. "Improvements in ceiling roses or attachments for pendant electric lamps." J. G. S. LEE. Dated June 22nd.

11,406. "Improvements in the electrical equipment of railway vehicles for the purpose of lighting, skating and ventilation." A. ZEYDEN. Dated June 23rd. (Complete.)

11,429. "An improved electro-magnet of high attractive force." M. VOSELSANG and F. LINDENSTRUTH. Dated June 23rd. (Complete.)

11,437. "Improvements in electric insulators." E. RIETER. Dated June 23rd.

11,438. "Improvements in casings for the jointings of underground electric cables." SIEMENS BROS. & Co. LIMITED, W. DIESELHORST, and F. J. BUDD. Dated June 23rd. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

15,236. "Improvements in electrical time switches." A. J. Wheatley. Dated July 12th, 1898. Relates to an improvement upon the time switch described in Specification No. 23,625, A.D. 1897, the mercury contacts being replaced by metal springs. 1 claim.

15,867. "Improvements in cells applicable for the production of chlorine and alkali metal amalgams by electrolytic decomposition of solutions of alkaline solutions." J. W. Kynaston. Dated July 21st, 1898. To obtain alkali metal amalgams and chlorine by the electrolytic decomposition of solutions of alkaline chlorides a cell is used consisting of a flagstone or like enclosure, the joints of which are made tight by the insertion of rubber cords in grooves, and which is firmly braced together by external brackets and bolts. Along the whole length of each side is a series of narrow shelves of stone, slate, glass, ebonite, vulcanite, &c., each shelf being hollowed out on the upper surface, and provided, alternately at opposite ends, with a raised portion or ridge somewhat lower than the edge. Over this weir mercury, which is continuously admitted to the upper shelf by a pipe, can flow to a perforation leading to the next shelf below. The mercury thus flows along each shelf in succession to the bottom, where it also forms a shallow layer, finally escaping by the tube. The mercury forms the cathode, and each layer is independently connected up. A central vertical carbon anode is used. The alkaline chloride solution, at a temperature at or near to its boiling point, is admitted to a level above that of the highest shelf. On passing the current chlorine is evolved and passes away by the pipe while the mercury gradually changes to an amalgam. In a modification, two carbon anodes are placed at a distance apart, and within the space between them another set of cathode shelves is arranged. 3 claims.

15,972. "Improvements in electricity meters." G. Hookham. Dated July 21st, 1898. Relates to energy meters. A commutator motor meter is constructed with an iron-cored armature, to reduce the energy wasted by the meter. The core may be a laminated ring, made in halves, to receive the coils, which consist of bobbins separately wound with numerous turns of fine wire. The armature is supported within main-current field coils by an pluminium disc on a spindle, which rotates in bearings on a frame, and is geared to a counter. The provisional specification states that a float may be provided under the armature to relieve the bearings of most of its weight. The commutator is a flat cone, upon which two plain crown wheels or two platinum wires bear as brushes. These wires are carried by flat springs on ebonite blocks, which are supported on a horizontal pin at the back of the frame, and have iron wire arms bent down into solenoids conveying the main current. This arrangement may be modified. The weight of the parts hold the wires lightly on the commutator, but the contact is improved by the pull of the solenoids on the arms when the main current is large. The spindle carries a brake disc between the poles of two permanent magnets arranged so that only their neutral parts are near the armature. Any field due to the permanent magnet is neutralised by winding the extra resistance for the armature circuit on the shorter limb of a J-shaped iron core, which is fixed vertically between the permanent magnets. The armature may be screened by a sheet-iron cup or disc carried by the spindle. The brake magnets are choked at both poles. One or more poles may be made long enough beyond the choke to carry a few turns of the main conductor, to correct the meter for errors at high loads. Otherwise a separate electro-magnet may be used for this purpose. The permanent magnets and extra resistance are fixed on a back-plate; all other parts, including terminals, are on the frame, which is hinged to the back-plate and can be turned outward to afford access to the parts, or secured by a screw. Quantity meters having armature discs immersed in mercury, described in Specification No. 14,239, A.D. 1892, may be provided with brake magnets having choked pole-pieces and windings as described above, to correct for fluid friction at high load. 5 claims.

16,114. "Improvements in connection with telephones for recording the number and duration of telephonic conversations." J. Frank. Dated July 23rd, 1898. Relates to apparatus for registering the time occupied by and the number of telephonic conversations. The telephone lever is connected by a link with a pivoted lever which in turn is connected by a link with a bell-crank lever. When the telephone is taken off its bell-crank lever rises, separating one set of contacts and closing another set of contacts; the latter puts a magnet in circuit and, when the magnet is actuated, causes a slide rod again to close contacts which are in the conversation circuit. When the subscriber wanted replies, by ringing, the current passes through the magnet causing the rod to slide so that the clockwork is released by a brake rod. The pivoted lever when moved releases the supporting lever, so that when the clockwork is released apparatus slowly falls until it breaks contact on the expiration of the time limit. The release of the pivoted lever also releases the counting lever. Hanging up the telephone winds up and resets the counting mechanism and also the slide levers. 8 claims.

16,128. "Improvements in the electrolysis of solutions of alkali salts, especially alkali chlorides." O. Imray. Dated July 23rd, 1898. Relates to the continuous electrolysis of solutions of alkaline salts, especially alkaline chlorides, to obtain the corresponding hydrate solution and chlorine gas. The anode is covered by a bell which extends some distance below it, while the cathodes are outside the bell and generally at a lower level. The electrolyte is introduced through a tube to the top of the anode compartment. The chlorine as it is formed passes up through the anolyte, thereby agitating and mixing it, and escapes through the tube. The caustic alkaline solution overflows from the tube. By this arrangement the layer formation of the anode and cathode liquids is maintained without the use of a diaphragm. 1 claim.

16,172. "A voltaic battery bell with hot air depolarisation." H. de R. de Lavison. Dated July 26th, 1898. The invention consists in effecting depolarisation by hot air, and is described as applied to a battery with zinc and copper plates immersed in a solution of copper sulphate with some sulphuric acid, the strength of the solution being maintained by a supply of copper sulphate stored in a reservoir. Each zinc plate is enclosed in a porous casing of parchment paper or the like, which is contained in a frame of insulating material such as celluloid, and is separated from the copper plates by bands of rubber or the like. Under each of the copper plates is fixed a tube perforated with fine holes, and connected to an upright tube, communicating with a general supply tube. The battery is first heated to about 60° C., when the air is blown in and acquires the temperature of the surrounding liquid. 1 claim.

16,291. "Improvements in alternating current transformers." L. M. J. C. Levavasseur. Dated July 26th, 1898. Relates to transformers for induction coils. The laminated iron circuit is built up of a number of plates insulated by paper or varnish. A sheet of paper is bent over a plate, and a strengthening thread or cord inserted along the fold, the operation being preferably carried out in a mould. The primary may consist of several windings separated by paper or the like. The coils are preferably arranged with the secondary between two sections of the primary, or with the primary between two sections of the secondary. The casing consists of two iron end plates or boxes and a wooden frame, the whole being bound together by bolts. The ends of the wires are fixed to terminals and enclosed in paper tubes. 3 claims.

16,299. "An alternating-current interrupter for induction coils." M. Kohl. Dated July 26th, 1898. Relates to an interrupter for alternating currents for induction coils designed to break the circuit when the current is approximately at its maximum. The magnet causes the armature mounted on a spring to vibrate synchronously with the current. This armature carries a contact dipping into a mercury cup. The position of the magnet is adjusted by means of the screw and the height of the mercury cup by the screw. In another arrangement, a synchronous motor, acting through a crank and connecting rod, reciprocates a vertical contact dipping into a mercury cup. 3 claims.

16,386. "Improvements in and appertaining to the working of incandescence electric lamps." D. MacLagan. Dated July 27th, 1898. Incandescent lamps having filaments which conduct only after preliminary heating by adjacent wire coils or the like, are provided with switches for disconnecting the heating circuits when the filaments have become conductive. In one arrangement the heating-coil is connected in parallel with the filament, through a time switch of any construction, which automatically opens the heating circuit when this has been closed for a sufficient time. In another arrangement several filaments are connected in parallel, and are all heated by one coil, the circuit of which is closed by a switch until one of the filaments becomes conductive. In the arrangement shown, current is supplied to the coil through a spring and a screw. Simultaneously current passes from the screw through a spring, a lever, and an electro-magnet which attracts an armature lever. This shifts the lever, breaking its contact with the spring and causing a pawl to turn a ratchet wheel and a four-armed switch. The switch connects any one of the filaments in circuit through another electro-magnet, and a reverse winding on the former magnet. The armature lever then moves to the right, opening the heating circuit by moving the first-mentioned spring. The provisional specification mentions the use of such apparatus to shift the filaments. In a modification of the arrangement shown a single filament only is provided, the ratchet switch and pawl lever being dispensed with. The armature lever is adapted to close the heating and filament circuits through the magnets, and afterwards open the heating circuit and connect a resistance in parallel with the second magnet in series with the filament. In a further modification, the second magnet is dispensed with. Solenoids and movable cores may be substituted for electro-magnets and armatures in either arrangement. 7 claims.

16,449. "Improvements in conduits for electrical conductors." F. D. Kenney and W. V. Morton. Dated July 28th, 1898. Conduits are made in lengths of iron pipe of flat section, these lengths being joined together airtight in the usual way. At convenient intervals parts of the pipe are made thicker with a lateral opening closed by a cover with an air-tight joint. The cables are placed in the conduit, and are insulated from each other by paper. Access is obtained to the cables through the doors. The wires are led out through insulating plugs screwed in the pipes. To expel and prevent access of moisture to the conduit air is pumped into it so as to keep the interior at a pressure a little higher than the atmosphere. The provisional specification states that calcium chloride, &c., may be placed in receptacles at intervals in the conduit, suitable connections being made between the receptacles to test the hygroscopic condition of the interior. 1 claim.

16,460. "An improved automatic safety device specially applicable to three-wire or balanced systems of electrical distribution generally." Veritys, Limited, and L. J. Steele. Dated July 28th, 1898. Relates to means for disconnecting the circuits in three-wire or "balanced" systems in case of unequal loading. Consists of an arrangement which operates when the fuse on the middle wire blows. The contact arms are held up against a spring by a catch. A solenoid is in shunt with the fuse and its core is connected to the catch. Should the fuse blow the core is raised and the arm released. In a modified arrangement the fuse is directly connected to the catch and holds it in position against the pull of a spring. In a further modification the solenoid is differentially wound, its extremities being connected to the outside wires. 2 claims.

16,464. "Improvements in the construction of electrodes for secondary batteries." A. Hennston. Dated July 28th, 1898. The electrode is formed by winding lead ribbons, wires, or the like into a cylindrical or prismatic shape. The electrode is not enclosed in a casing; it is fitted with a head and a radial slit is made down the whole length of the electrode to allow for expansion. 5 claims.

16,485. "Improvements in axles and steering gear for electric and other motor carriages." H. W. Headland, H. W. Headland, jun., J. T. Robson, and C. H. Marsden. Dated July 28th, 1898. Relates to axles and steering gear for electric and other motor carriages. The swivelling cranked axles each have a vertical portion integral with the horizontal part on which the road wheel is mounted. The vertical portion at the upper end is guided in a sleeve projecting from a bridge-piece and at the lower end in a bearing on which rests the spring. The vehicle body rests on brackets attached to the upper members of the springs and guided on the sleeves. The adjustment of the steering wheels may be effected either by pinions and toothed sectors carried by the axles, with provision for avoiding back lash, or by some suitable arrangement of worm gear. Springs on a prolongation of the axle or between the bearings may be provided for supporting or containing batteries or motors. 3 claims.

16,488. "Improvements in the method of and apparatus for starting and controlling electric motors." T. Proece and J. A. Edmondson. Dated July 29th, 1898. Motors are started and controlled by means of a resistance switch provided with sliding contacts which, when the motor has been thrown into circuit, are held on by means of an electro-magnetic clutch or brake. The resistances are mounted between two non-conducting slabs, and connected to a series of fixed contacts. Between these contacts and a contact plate is arranged a sliding-contact box, provided with connecting arms and electro-magnetic brake arms. In starting the motor, the contact box is raised by a windlass, and is held in any position by the action of four electro-magnets contained in the box. When the electro-magnets are short-circuited by a switch, the contact-box automatically returns to the off position. An electro-magnet is provided in the main circuit, which automatically short-circuits the brake magnets when the current exceeds a certain limit. 4 claims.

16,552. "Improvements in electrodes for arc lamps." H. Bremer. Dated July 29th, 1898. Relates to arc lamps. A positive electrode of pure carbon is employed below a negative electrode made of calcium carbide or a mixture of carbon and lime or like incandescing substance, optionally with a core containing a larger proportion of lime, &c., or both electrodes may contain lime. They may be made by compressing and carbonising saw dust, to which, chalk, lime, magnesia, or the like may be added. A larger arc and more light are stated to be obtained with such electrodes than with pure carbons, its colour also differing. 5 claims.

16,553. "Improvements in electric arc lamps." H. Bremer. Dated July 29th, 1898. Relates to arc lamps. A lamp is provided with tubular carbons or with several pairs of carbons in one globe, connected in series or in separate circuits. The pairs may be controlled by separate mechanisms or by one single mechanism; in the latter case all the carbons except one pair are mounted on springs in order that they may come in contact before such pair. These arrangements are specially applicable to lamps having long arcs produced by adding metallic salts to the carbons, which are placed in vacuo. 2 claims.